APRIL 1951

THE SCIENCE TEACHER

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THOMAS JEFFERSON

- pH Preferences of Common Plants
- Foundations, Industry, and Education
- Getting Started in the Teaching of Photography
- Conservation Education in American Schools
- Classroom Ideas and Demonstrations

JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION

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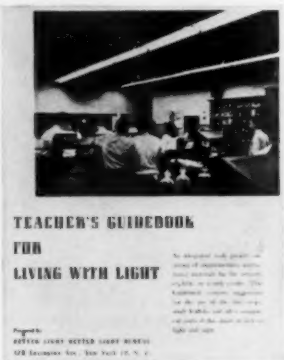

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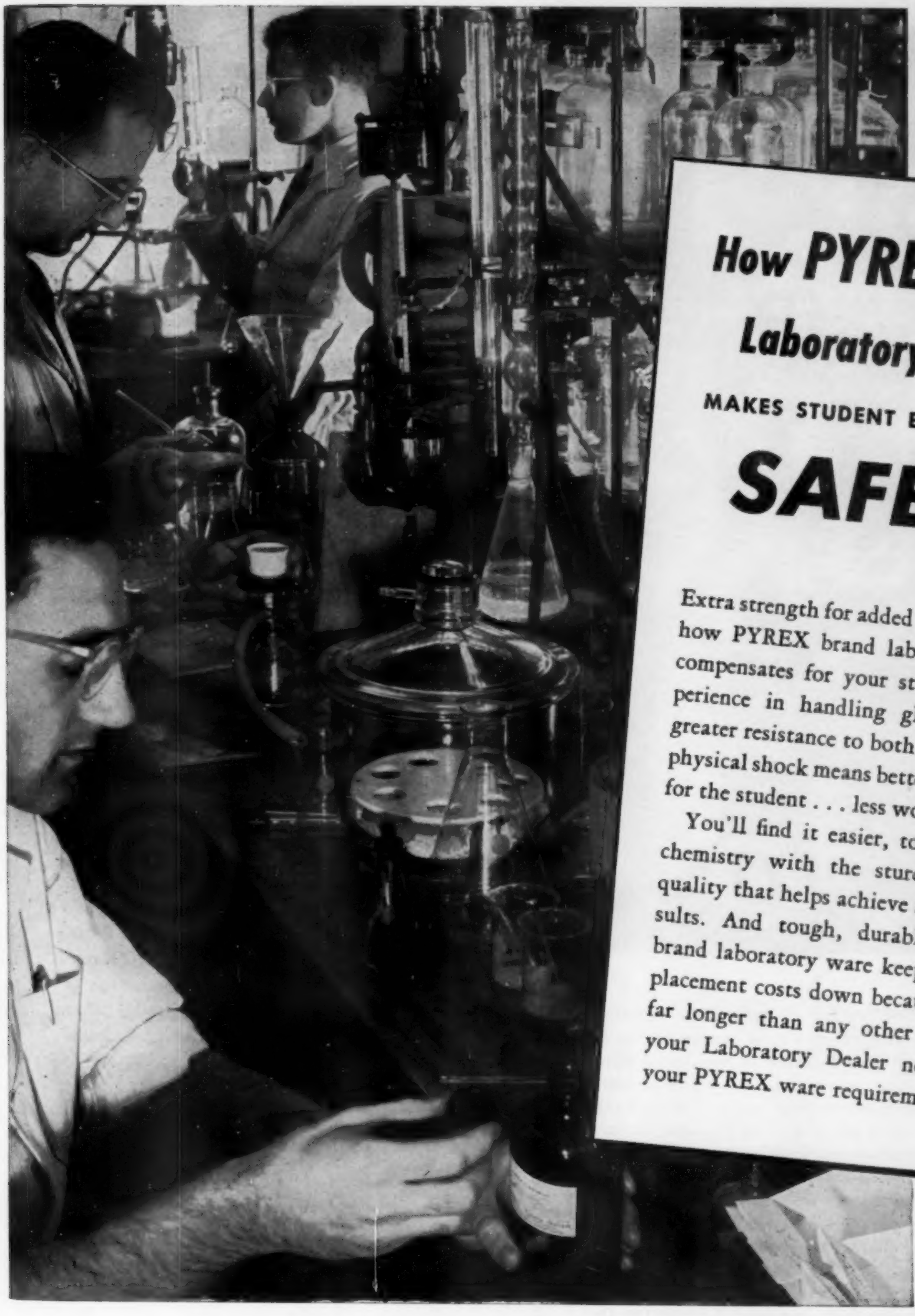

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THIS MONTH'S COVER. April 13 being Thomas Jefferson's birthday, this issue offers a good opportunity to let our admiration for the third president of the United States be known. His views on science are no less remarkable than his views on social and political issues. The profound wisdom of the man gave his utterances a quality of continuing timeliness that amazes us of such lesser abilities.

The Jefferson Memorial on the banks of the Tidal Basin in Washington is, to us, one of the two most inspiring spots in our nation's capital—the other being the Lincoln Memorial. The inscription which encircles the inner dome of the Jefferson Memorial seems to us to carry tremendous meaning for scientists. For some insight into Jefferson's views on science (page 168) we are indebted to Dr. Julian Boyd of Princeton University Library, editor of "The Papers of Thomas Jefferson." Photo by Horydczak.

Guided Missives

Editor

The Science Teacher:

First, allow me to congratulate you on the extraordinary improvement in *The Science Teacher*. . . . For myself, I read the experimental notes in your journal first, as I do with the British SMA journal. You should aim at *pages* of such notes in each issue.

I have picked up some good things in your packet service also.

V. N. Bruce
Ottawa, Ontario
Canada

Editor's note: Congratulations accepted with thanks on behalf of all TST editors and contributors. As for *pages* of "Classroom Ideas and Demonstrations," we'd like that, too. Again we say—"Contributions invited."

Editor

The Science Teacher:

From its first issue I have had a deep uneasiness about the "pepped up" appearance of your magazine. I think that teachers, especially science teachers, should maintain a greater appearance of dignity. We should not readily succumb to the bizarre attempts of many magazines to attract attention, to lull the unwary into reading something in which he may have no real interest, or to mix the serious business of science with whimsical humor. Imagine my surprise to see the hideous cartoons in the article beginning on page 85 of your March issue. They are unworthy of us. Many will think that such caricatures reflect upon our students. The development of "critical thinking" in these serious times is no laughing matter.

A Retired Teacher

THE SCIENCE TEACHER

Journal of the
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Editor

The Science Teacher:

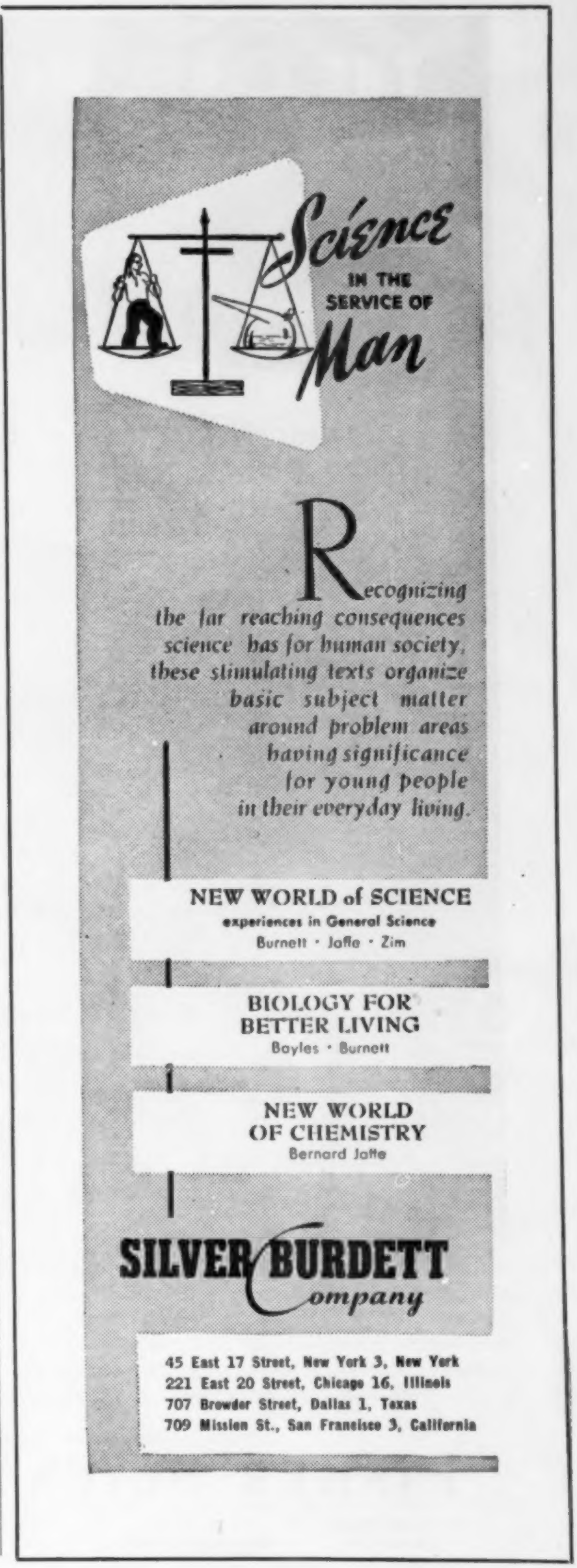
In the November, 1950, issue of *The Science Teacher* Michael Adragna explained the use of phenylthio carbamide to demonstrate the Mendelian law of inheritance in class. There is another demonstration which can be used very easily and effectively in class.

Tongue-curling ability is a hereditary muscular characteristic which some of the pupils in the class are almost sure to have. About 67 per cent of all women and 63 per cent of men can do this simple trick. Some authorities believe this trait was produced by mutation. It is definitely inherited.

To demonstrate this ability, ask the children to make a long tube of their tongue by curling up the lateral edges. Some can; many cannot. The home assignment for the evening is to find out from whom (mother or father) this ability is inherited. This demonstration makes a hit with the children as they are interested in specific instances of heredity in themselves and also because it gives them a chance to stick out their tongues at the teacher without dire consequences!

Another demonstration that is often useful is to ask the children to pick out ways in which they resemble their parents and their brothers and sisters. This is particularly successful when the brothers and sisters are still in school or are well known to many in the class.

CLARE F. SMITH
Washington, D. C.



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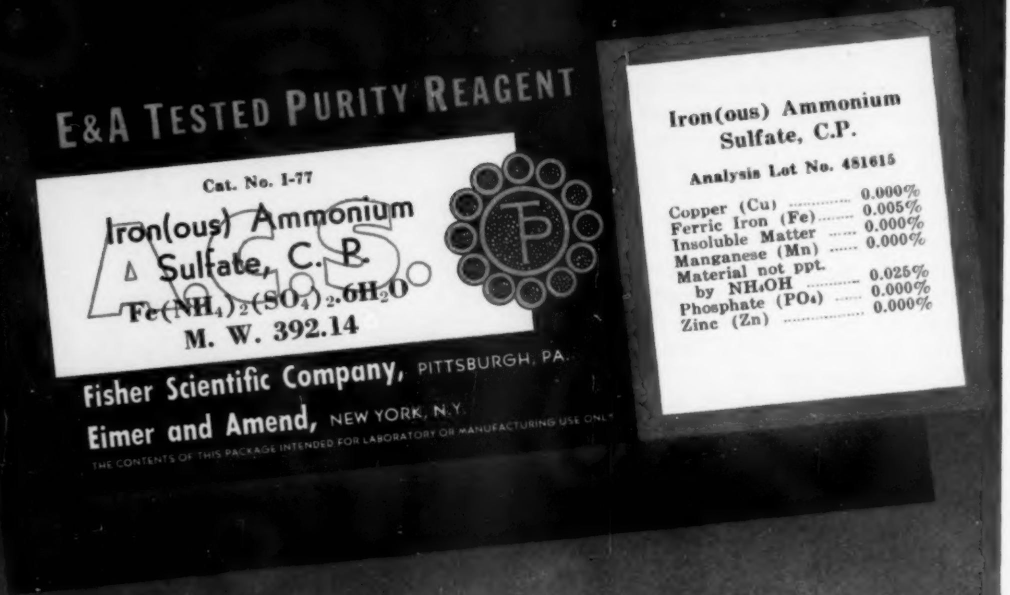

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THE SCIENCE TEACHER

Vol. XVIII, No. 3 **April, 1951**

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The National Science Teachers Association is a Department of the National Education Association and an Affiliate of the American Association for the Advancement of Science. Established in 1895 as the NEA Department of Science Instruction, the Association later became the American Council of Science Teachers. It merged with the American Science Teachers Association and reorganized in 1944 to form the present Association, and **The Science Teacher** became the Official Journal of the new National Science Teachers Association.

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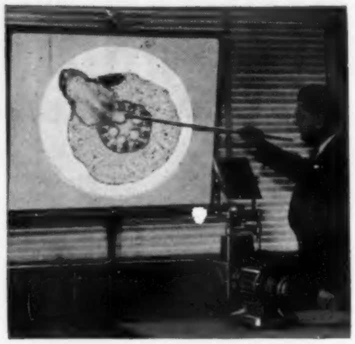

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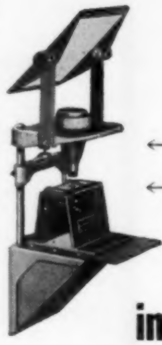

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Editorial

In the Febrary, 1951, issue, of the *Journal of Chemical Education,* Editor Norris Rakestraw reminds us, "One frequently meets the opinion that the standard of teaching in the secondary schools is very much superior to that in the colleges. . . ." Most of us have met the corollary opinion that college teachers aren't much concerned with pedagogy anyway. Don't believe it! Indeed they are. Three recently published discussions centering on the question will help make my point.

First is Dr. Rakestraw's editorial referred to above. Seeming to accept the comparison, he points out that "there is little incentive to good teaching in our large universities, first, because of the crushing effects of waves upon waves of students . . ."

On the other hand University of Illinois botanist Harry J. Fuller, in his article "The Emperor's New Clothes, or Prius Dementat" (*The Scientific Monthly,* January, 1951), really lashes out at the professors of education and the contemporary training of students, particularly in high schools. He believes that the situation is pretty bad.

Whether or not the standard of teaching is higher in the secondary schools, Editor R's explanation, I feel, is rather absurd. "This is not to be wondered at, perchance," he says. "The high school teacher has practically nothing to do *but* teach (in terms of quantity, unfortunately, plenty!) while the college teacher has—for better or worse—other things on his mind."

Nothing to do *but* teach: probably three different preparations and five classes *every school day*—perhaps 150–200 pupils daily—plus a homeroom and a study hall; maybe a period of lunchroom or playground supervision; no laboratory assistant; faculty and/or committee meetings an afternoon or two each week; advisor to the fire safety committee and sponsor of the science club; helping coach soccer during fall and track or tennis during spring; responsibility for the school's visual aids program; etc.

To those who would *understand*—or criticize—today's secondary school, I would recommend that they actually go and "live the life" of the high school teacher for one month. As physicist Laurence E. Dodd of the University of California says in the *American Journal of Physics,* January, 1951, "the individual pupil is expected to develop nowadays by being put largely on his own resources, under competent supervision, to accomplish what he can individually . . . (the teacher) must encourage the student toward increasingly firmer reliance on his own work."

All of us—including Dr. Fuller, I'd guess—are seeking this goal.

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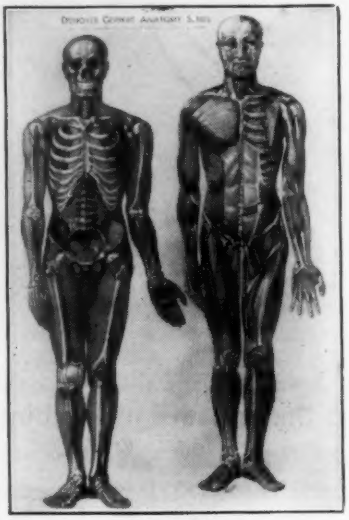

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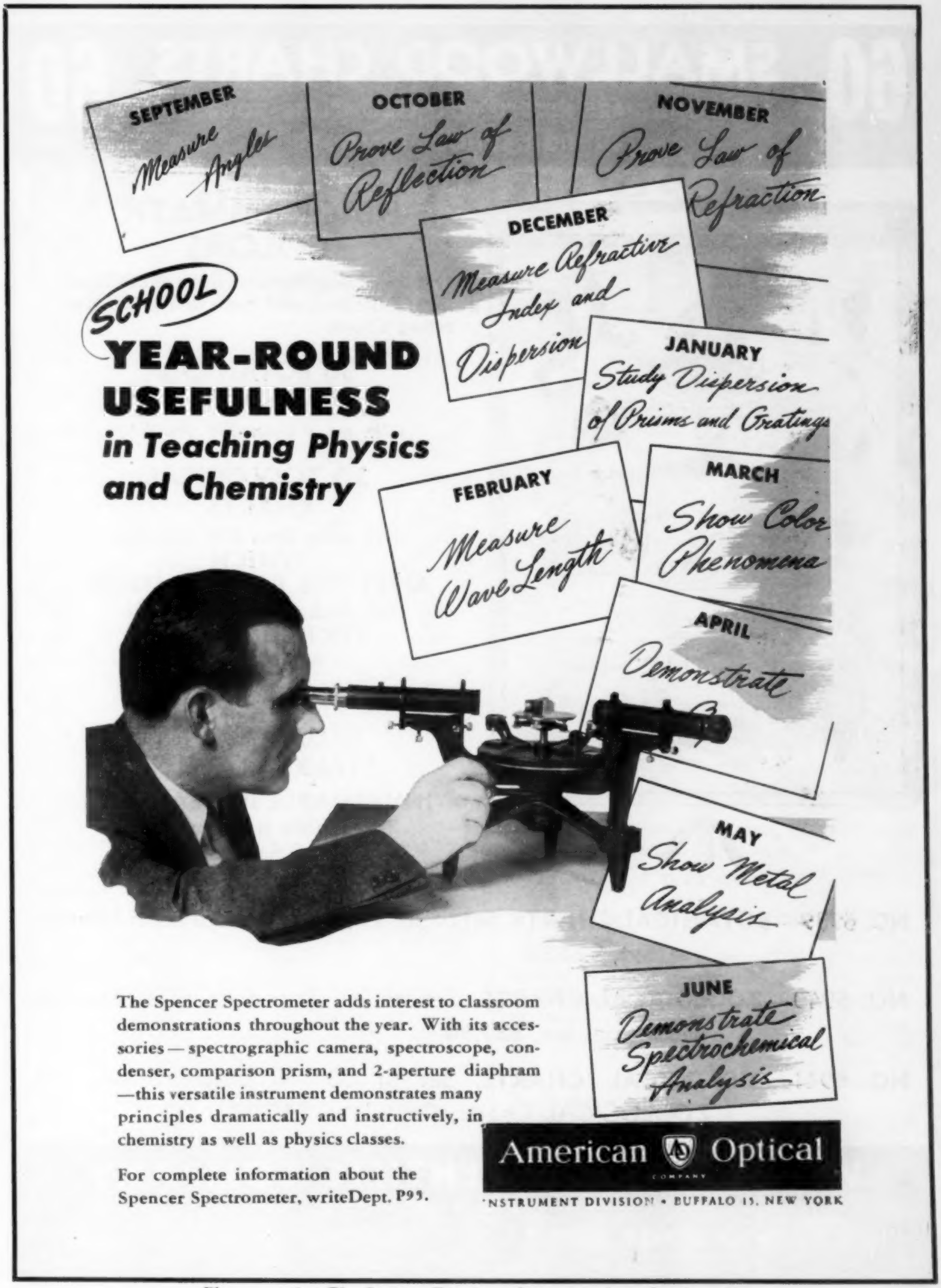
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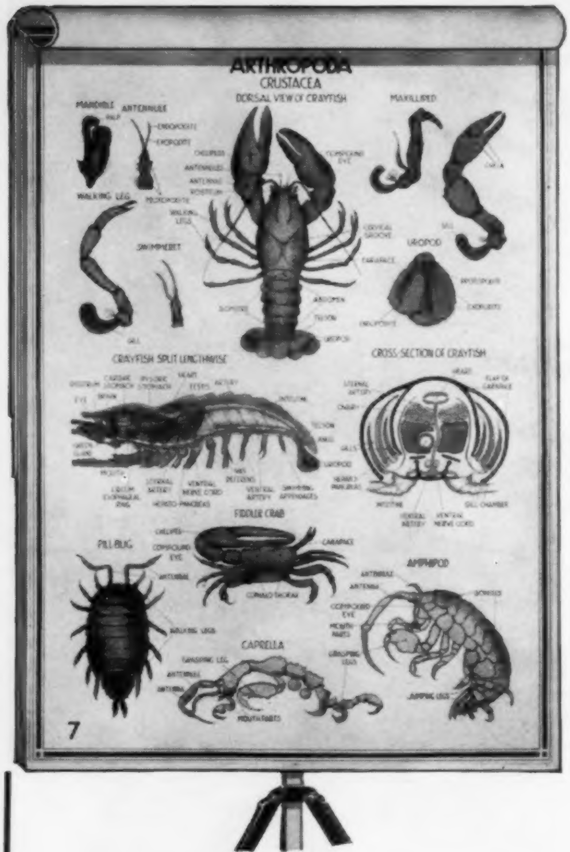

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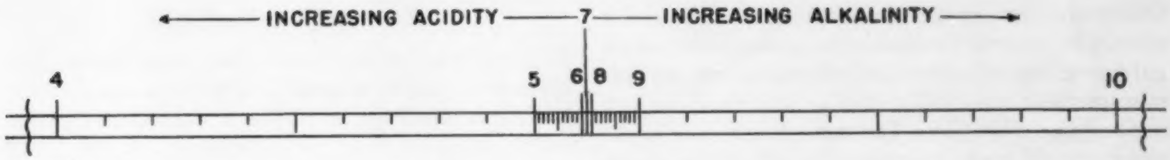


pH Preferences of Common Plants

By WALTER S. LAPP
Teacher of Chemistry
Northeast High School, Philadelphia

and

EDGAR T. WHERRY
Professor of Botany
University of Pennsylvania, Philadelphia

THE PURPOSE of this article is to call attention to an important factor in plant growth which often is not adequately treated in high school science courses. This factor is the pH of the soil. Many plants and crops will not grow properly unless the pH of the soil is within a certain range. Among the points treated are a discussion of the pH scale, procedures for sampling and testing soils, directions for adjusting the pH value of soils, and a classification of some plants and trees according to pH preference.

The study of pH-plant-soil relations is a good example of the correlation of chemistry, botany, and agronomy. These relations should constitute a part of the laboratory and field work of science classes. Many students, especially those in rural areas, should find this problem of interest in working out projects for science fairs.

The pH scale is a scheme for measuring the intensity of acids and bases in solution. The scale, which ranges from 0 to 14, is reproduced above. The neutral point is pH 7.0. Any value between 0 and 7 is acidic. Any value between 7 and 14 is alkaline or basic. The relationship between points on the pH scale is logarithmic. Therefore .each pH unit is ten times as great in value as the one next approaching 7. For instance:

pH 5 is 10 times as acid as pH 6
pH 4 is 100 times as acid as pH 6
pH 3 is 1000 times as acid as pH 6
pH 9 is 10 times as alkaline as pH 8
pH 10 is 100 times as alkaline as pH 8
pH 11 is 1000 times as alkaline as pH 8

The pH scale is widely used in industry and research as a means of control in all sorts of processes involving acids and bases. LaMotte (**9**) says:

> Today, we find the term "pH" to be a part of the routine vocabulary of practically every technical man, and the usefulness of the subject in general has benefited so many processes that it is now an accepted operating factor.

Shall we teach the facts and principles first and then go on to point out uses and applications? Or shall we begin with a problem or bothersome situation and then go on to dig out the relevant facts, develop the principles involved ,and thence lead into their wider applications?

This article is not concerned at all with the pedagogical problems posed above. Proponents of either school of thought will find in "pH Preferences of Plants" both information and ideas to help make science teaching practical and more functional. However, you don't have to be a science teacher to make good use of this article—not if your lawn and garden resemble your editor's!

Dr. Lapp's Ph.D. thesis (University of Pennsylvania, 1942) dealt with *Factors Affecting the Growth of Lawn Grasses.* He has done research on the development of 2,4-D and other herbicides. His services as a consultant on turf and weed problems have been utilized widely, and he has given courses on soils and lawns at the Pennsylvania School of Horticulture. He has been teacher of chemistry in Northeast High School, Philadelphia, since 1920.

Dr. Wherry has conducted extensive research on soil reactions in relation to plant growth. He is a prolific writer of technical articles in the fields of chemistry, botany, and geology. He is specially interested in wildflower conservation, and his hobby is the photographing in color of such plants and flowers.

While the farmer and horticulturist already use some pH control methods, the student and home gardener should also know about it and its significance.

Sampling the Soil. The sample of soil to be tested should truly represent the area from which it is taken. In sampling the soil from a garden or lawn, take five to ten thin slices to a depth of six inches for each 1000 square feet. If the soil is wet, let it dry indoors for a day or two and then make up a composite sample by mixing thoroughly. In testing the pH preference of a wild flower, the sample should be taken from the soil in direct contact with the feeding roots of the plant. In making up a composite sample, do not mix soil from different soil types. Make up a separate composite sample for each type. Do not mix samples that differ in nature such as: sunny and shady areas; wet and dry areas; high and low areas; good and poor crop areas; clay and sandy soil; and dark and light soil.

The Indicator. One of the simplest methods of measuring pH values is by means of an indicator or dye, the color of which varies with the degree of acidity or alkalinity—in other words, at different points on the pH scale. The second-named author (**16**) first suggested Brom cresol purple as a suitable indicator for soil tests in 1918 while he was with the United States Department of Agriculture. The advantage of this indicator depends upon the fact that it covers that part of the scale in which most common plants grow. It has sharply contrasting end colors: golden yellow at pH 5.0 or lower, and dark purple at pH 7.5 or higher. It is red-brown at its "midpoint," pH 6.0, which is the lower limit of the large group of circumneutral plants. Harper (**6**) in Oklahoma compared Brom cresol purple with other indicators in testing the pH of over 1000 soils and proposed that it be used in practice.

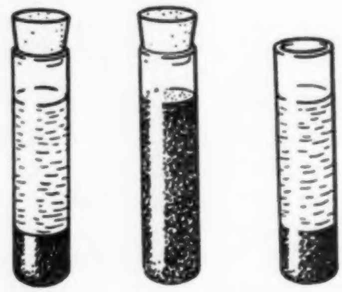
Brom cresol purple indicator solution can be obtained from dealers. If much is needed, it can be prepared by the following procedure. Dissolve one gram of BCP powder in 250 ml. of either methyl or ethyl alcohol. Dilute to a volume of two-and-one-half liters. Add limewater a few drops at a time until the color becomes a distinct red. Preserve in Pyrex containers and add a few crystals of thymol to prevent the growth of organisms.

Testing the pH of Soil

Direct method. By means of a knife blade place a pinch of soil on a small watch glass and cover it with several drops of indicator solution as in the

illustration above. Shake or twirl the watchglass gently to mix soil and indicator. After a minute or two the solution will show no further change. Compare with a color chart such as that of Clark (**3**) and interpret accordingly.

Extraction Method. Mix one volume of soil with four volumes of distilled water (or rain water) as in the tube on the left. Stopper and shake



the vial for half a minute. Let the water-soil mixture settle as in the tubes in the center and on the right (not less than five minutes nor more than one day).

Next put one drop of indicator solution on a watchglass as in the top illustration. Then, by means of a medicine dropper, transfer five drops of the clear soil extract to the watchglass as in the lower illustration. Compare with the color chart and interpret accordingly. While the extraction method takes more time, it requires less indicator solution and is somewhat more accurate than the direct method.

The indicator solution may be dispensed from a test tube fitted with a shaker top or from a dropper-stopper bottle. In either case the container should be of Pyrex glass.

Adjustment of Soil pH

The soils of North America vary widely in their natural pH values. The eastern forested soils are strongly acid and are known as "podzols." The black, fertile grassland soils of the central states are near neutral and are called "chernozems." The soils of the desert regions are distinctly alkaline. Among the factors correlated with the natural pH values of soils are total annual precipitation, mean annual temperature, and type of vegetation. In general, soils in humid areas tend to become acid because considerable amounts of the basic elements such as sodium, calcium, and magnesium are dissolved and carried away by percolating rainwater.

Liming Acid Soils. Plants which are decidedly acid in preference require no lime whatever. Those of the slightly acid group may require a small quantity if they are to be grown in exceedingly acid soils. For the circumneutral group the following amounts may be used if the pH is 6.0 or less:

Common Name	Chemical Name	Chemical Formula	Pounds/1000 sq. ft.
Quick lime	Calcium oxide	CaO	40
Hydrated lime	Calcium hydroxide	$Ca(OH)_2$	50
Powdered limestone	Calcium carbonate	$CaCO_3$	80
Powdered dolomitic limestone	Calcium Magnesium carbonate	$CaMg(CO_3)_2$	80

Light soils need less lime than heavy soils (**7**). In adjusting soils of pH 5.0 or less for circumneutral crops, the quantities of limestone to be applied may be of the order of: one to two tons per acre for sandy soils; two to four tons on silt loams; and three to five tons on clay soils high in organic matter (**13**).

Because magnesium is usually available to crops in much smaller quantities than calcium, it is generally a good plan to apply lime in the form of powdered dolomitic limestone. When the magnesium carbonate content is as much as 20 per cent, the limestone is spoken of as "dolomitic" or "high-magnesium" limestone. Pure dolomite contains 45 per cent magnesium carbonate. If too much dolomitic limestone should be applied, no harm will be done because the excess quantity will act like so much sand and will tend to lighten the soil (**2**).

Hydrated lime must be used cautiously because if it comes into contact with a complete fertilizer it will release much of the ammonia from the fertilizer. It is therefore best not to apply hydrated lime and fertilizer at the same time unless each is thoroughly and separately mixed with the soil.

The Functions of Lime. The only practical way to reduce or neutralize soil acidity is to apply some form of lime. Lime performs several distinct functions:

(1) It reduces acidity.

(2) It provides calcium and magnesium, elements which are needed in variable amounts by different plants.

(3) It may make the element phosphorus more soluble and therefore more available to plants.

(4) It reduces the toxicity of excessive quantities of aluminum, iron, and manganese by changing these elements into less soluble compounds.

(5) It makes heavy soils friable and tillable by converting fine clay particles into a crumblike structure. Unlimed soils tend to puddle when wet and on drying become almost as hard as bricks.

(6) It promotes essential biologic processes such as decomposition of organic matter and nitrification.

Acid Soil Beds. Special beds should be constructed whenever decidedly acid plants are to be grown in circumneutral soil areas. Excavate a foot or more of the original soil. Fill in with a mixture of one part acid sand and three parts acid peat, humus, rotten wood, or decomposing oak sawdust. Pine sawdust should not be used because its turpentine content is toxic.

When acid-loving plants are growing poorly on soils which are insufficiently acid, one of the acidifying agents mentioned in the accompanying tabulation should be applied. These materials should be raked into the upper inch of the soil. Many acid soil plants have shallow roots, and great care must be exercised not to disturb them. Furthermore, when the soil has been adjusted to the proper pH, it must never be assumed that it will remain at that value indefinitely. Earthworms are always at work bringing lime up from the subsoil. This tends to neutralize the acidifying agents. Therefore an acidity test should be made at least once a year and the soil pH adjusted accordingly. The following are the chemical acidifying agents generally recommended:

Common Name	Chemical Name	Chemical formula	Pounds/ 1000 sq. ft.
Alum	Aluminum sulfate	$Al_2(SO_4)_3$	25
Flowers of sulfur	Sulfur	S	25
Tannin	Tannic acid	$C_{14}H_{10}O_9$	25

Some Practical Implications

There are many practical implications of pH control of which only a few illustrations can be given. The Romans knew that lime was beneficial to legumes but did not know why. The use of lime in England is an old practice. Scarseth (**11**) in Indiana reported that in controlled field experiments with three- and four-year rotation including legumes $1.00 spent for lime on soils of pH 4.7 returned $12.34; on soils of pH 5.0 the dollar returned $5.70; and on soils of pH 6.0, $3.00.

In Puerto Rico, Gile (**5**) reported 40 years ago that an excess of lime caused chlorosis of pineapples. In other pineapple countries it has been observed that as far back in the fields as the wind can carry the limy dust from gravel roads the plants tend to become yellow and sickly. The excess of lime causes a deficiency of soluble iron and hence the chlorosis (**7**).

Spinach requires a circumneutral soil while potatoes need a moderately acid one in order to keep the scab under control. In lowland Virginia a plan has been worked out by means of which it is possible to grow both crops in the same fields year after year. In the fall when the spinach is planted a light and shallow application of lime is made. The following spring the field is plowed deeply. In this manner the lime is thoroughly mixed to plow depth with the result that natural leaching processes keep the soil acid enough for the potatoes.

In 1937 the first-named author (**10**) noticed from the train that the athletic field of the Reading Company at Tabor in Philadelphia was a patchwork of many kinds of turf. Investigation brought to light the fact that the field was seeded in 1893 and that since then nothing had been applied except lime along the lines marking the areas for such sports as football, soccer, and tennis. On careful examination it was found that along the "lime lines" there was an excellent stand of sturdy turf composed mainly of Kentucky bluegrass and white clover. All other parts of the field consisted of crabgrass, miscellaneous weeds, and a few patches of bent and fescue grasses. Soil tests revealed that the pH along the "lime lines" was about 8.0 and elsewhere about 5.0.

Those responsible for the maintenance of turf on large areas such as athletic fields, parks, cemeteries, estates, and even home lawns can well afford to apply the lesson of Tabor Field. This is not to imply that lime need be applied yearly. In general one application of 80 pounds of dolomitic limestone per 1000 square feet once every five to ten years is sufficient to maintain a satisfactory stand of dense turf providing other factors are favorable.

There have been numerous failures and serious losses in attempting to grow such acid plants as rhododendrons, azaleas, and laurel in soils containing too much lime. Sometimes the lime leaches into the acid bed from nearby walls or driveways. The symptoms are a chlorosis of the leaves. The veins usually remain green longer and are sharply outlined against the blade of the yellowing leaf.

The foregoing examples should suffice to show that pH control is an exceedingly important factor in plant growth. With many crops an abundance of lime is a prime necessity. In other cases it may be a deadly poison. It all boils down to a few facts concerning the availability of certain elements in soil and the individual nature of plants. Intensely acid soils are low in the availability of such important elements as nitrogen, phosphorus, calcium, and magnesium. Yet these same soils are high in the availability of aluminum, iron, and manganese (**12**).

The only safe practice then is to learn the pH preference of the plants one wishes to grow and then apply or withhold lime in accordance with carefully made soil tests.

Classification of Plants According to pH Preferences

The list of pH preferences is not intended to be exhaustive but rather illustrative. Those who wish more information should consult the references at the end of the article. In 1941 Spurway (**14**) published a list of about 1500 pH plant preferences, the most comprehensive list so far published. However, the recently published Eighth Edition of *Gray's Manual of Botany* (**14**) includes over 8000 species, varieties, forms, and named hybrids, found in northeastern North America alone. Gardeners are concerned with thousands of species from other regions too. This indicates how much more research is needed on this subject (**1, 8, 15**). Plants have been classified here as:

Group I CIRCUMNEUTRAL (pH 6.0–8.0)
Group II SOMEWHAT ACID (pH 5.0–7.0)
Group III STRONGLY ACID (pH 4.0–5.0)

This classification is not to be thought of as absolutely rigid. In the main the plants have been observed to thrive best in the ranges where they have been listed. However, some are less particular than others and will grow at values distinctly higher or lower than indicated by their places in the lists.

Group I Circumneutral Plants pH 6.0–8.0

Brownish-red to dark purple with BCP

Native and Ornamental Herbs and Shrubs

Abelia
Alyssum
Barberry
Bluebells
Butterflybush
Campion, Starry
Canna
Carnation
Cockscomb
Convolvulus
Cosmos
Cotoneaster
Crocus
Dahlia
Daisy
Delphinium
Deutzia
Eunonymus
Fleeceflower
Forsythia
Four-o-clock
Gaillardia
Geranium
Grape Hyacinth
Hawthorn
Hibiscus
Honeysuckle
Hydrangea,
  Pink-flowered
Ivy
Jack-in-the-Pulpit
Lilac
Marigold
Mockorange
Narcissus
Peony
Periwinkle
Petunia
Poppy
Primose, Evening
Pyrethrum
Sage
Snapdragon
Spirea
Tulip
Violet
Wisteria
Yucca

Crops and Grasses

Alfalfa
Barley
Beets, Sugar
Cane, Sugar
Clover
  Red, Sweet, and White
Corn, Kafir
Grass
  Buffalograss, Canada-blue, Crested Wheat, Grama, Kentucky blue, Merion blue, Ryegrass, Shady blue, St. Augustine, and Timothy
Sunflower

Food Plants

Artichoke
Asparagus
Banana
Beans, Most
Beets, Table
Brussel Sprouts
Cabbage
Cantaloupe
Celery
Collards
Currant
Grapefruit
Horseradish
Kale
Kohlrabi
Leek
Lemon
Lettuce
Mint
Mushrooms
Okra
Orange
Peas, Garden
Spinach
Swiss Chard

Trees

Ailianthus
Apple, Crab
Arborvitae
Ash
Beech
Cherry
Elm
Locust
Maple, Sugar
Mulberry
Oak, English
Pear
Pecan
Plum

Group II Somewhat Acid Plants pH 5.0–7.0

Light yellow to light purple with BCP

Native and Ornamental Herbs and Shrubs

Anemone
Azalea
Bayberry
Bearberry
Beautyberry
Beebalm
Bellflower
Begonia
Bittersweet
Blazing Star
Bleeding Heart,
  Fringed
Bluets
Broom, Scotch
Calendula
Candytuft
Chokeberry
Chrysanthemum
Cineraria
Columbine
Coleus
Coreopsis
Dalibarda
Eupatorium
Everlasting, Pearly
Fern
  Grapefern, Lady, and Wood
Fuchia
Gladiolus
Goldenrod
Gourd
Greenbrier
Heather
Hobblebush
Iris
Juniper, Creeping
Laurel, Mountain
Leucothoe
Lily
Lily-of-the-valley
Nasturtium
Partridgeberry
Pear, Prickly
Phlox
Pipsissewa
Privet
Pussytoes
Pyrola
Rose
Scabiosa
Selaginella
Violet, Birdsfoot
Wintergreen
Virginia Creeper
Zinnia

Crops and Grasses

Buckwheat
Clover, Alsike
Cowpeas
Flax
Grass
  Bermuda, Carpet, Centipede, Chewings Fescue, Colonial Bent, Creeping Bent, Creeping Red Fescue, Fine-leaved Fescue, Meadow Fescue, Orchard, Redtop, Sheep Fescue, Tall Fescue, Velvet Bent, and Zoysia
Hemp
Lespedeza
Lupine
Millet
Oats
Rape
Rye
Soybeans
Tobacco
Trefoil, Birdsfoot
Wheat

Food Plants

Beans, Lima
Broccoli
Carrots
Cauliflower
Chives
Corn
Cucumber
Current, Red
Eggplant
Endive
Garlic
Gooseberry
Grape
Onion
Mustard
Parsley

Group II FOOD PLANTS (*continued*)

Parsnip	Rhubarb
Peanut	Shallot
Pepper	Salsify
Pineapple	Squash
Potato	Strawberry
Pumpkin	Sweetpotato
Raddish	Tomato
Raspberry	Turnip
Watermelon	

TREES

Apple	Holly
Birch	Juniper
Cedar, Red	Linden
Chestnut	Maple, Striped
Chinquapin	Oak, Most
Cypress, Bald	Pine
Dogwood, Flowering	Shadbush
Fir, Balsam	Silverbell
Fir, Douglas	Spruce, Colorado
Franklinia	Spruce, Norway
Hazelnut	Spruce, Sitka
Hemlock	Spruce, White
Tung-oil	

Group III Strongly Acid Plants pH 4.0–5.0

Golden yellow with BCP

NATIVE AND ORNAMENTAL HERBS AND SHRUBS

Alpine-Azalea	Laurel, Sheep
Arnica	Moss, Sphagnum
Blue bead	Orchid, Fringed
Bog-Rosemary	Pepperbush, Sweet
Bunchberry	Pineweed
Calla, Wild	Pitcherplant
Clubmoss	Pogonia
Featherfleece	Rhodora
Fern	Sandmyrtle
Chainfern and	Solomon's Seal, Dwarf
Climbing	Stagger Bush
Galax	Starflower
Goldthread	Stargrass
Hydrangea, Blue-	Sundew
flowered	Swamp Pink
Indigo, Yellow False	Trailing Arbutus
Iris, Cubeseed	Trillium, Painted
Iris, Vernal	Turkey Beard
Labrador-Tea	Twinflower
Ladyslipper	Twisted-stalk
Leatherleaf	Venus Flytrap
Laurel, Bog	Viburnum, Maple-leaf

FOOD PLANTS

Blueberry, All
Cranberry
Dewberry
Huckleberry, Black
Huckleberry, Box

TREES

Ash, Mountain
Cedar, White
Holly, English
Oak Scrub
Pine
Jack, Longleaf, Mountain, and Pitch
Spruce
Black and Red
Sweetbay

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CONTROLLING PLANT GROWTH

By BETTY F. THOMSON
Department of Botany
Connecticut College
New London

—With Chemicals

In the past 20 years a brand new and different tool has been put in the hands of those who would regulate the growth of plants, whether as a means to increase the abundance of crops or to acquire a fuller understanding of the processes involved in growth. This tool is the use of specific chemical compounds to bring about specific biological effects.

Here is a double-barreled article. It gives background information on the growth of our knowledge about plant hormones and auxins, and it suggests ways of demonstrating and experimenting with these chemical agents of growth control.

This article is double-barreled from another point of view: it emphasizes the essential "oneness" of science; the things to do which it suggests may be done with equal appropriateness in either biology or chemistry.

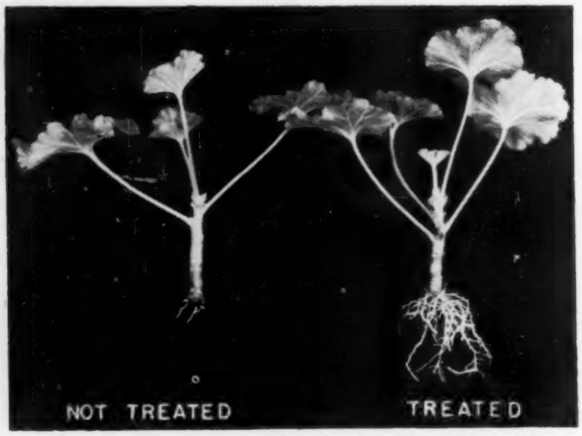
Dr. Thomson is specially interested in the fields of plant morphogenesis and developmental morphology. At Connecticut College, she teaches "assorted botany courses."

The history of our knowledge of such substances goes back to Charles Darwin. As long ago as 1880 he showed by simple experiments that grass seedlings exposed to light from one side fail to bend if their tips are cut off or even shaded with a dark cap, although the actual bending takes place in the lower part of the shoot. He concluded from this that "some influence is transmitted from the upper to the lower part, causing the latter to bend." It was 30 years later that the botanist Boysen Jensen showed this "influence" to be a chemical substance that can pass through nonliving material, such as a layer of agar jelly placed between a cut-off grass tip and the decapitated stump, or can be removed from one plant and applied to another and still produce its characteristic effect. Here then was a chemical messenger, or hormone: a substance that is produced in one part of an organism and transported to another part where it has its effect.

The next problem was to discover the chemical identity of the active substance. Like other hormones this one is present in living tissues in amounts far too small to be detected by the usual analytical chemical methods. A serious bottleneck was eliminated in 1928 when F. W. Went in his paper "Wuchsstoff und Wachstum" described the oat coleoptile-curvature method for detecting and measuring plant hormones. The method consists in brief of applying small blocks of agar jelly containing the supposed hormone to one side of decapitated oat coleoptiles under standard conditions. If the agar contains an active substance, the coleoptile bends away from the agar block. Moreover, the degree of bending is proportional to the amount of hormone present. Results can be recorded in the form of photographic shadowgraphs and the angles of bending measured with a protractor. With this delicate but essentially simple technique substantial progress became possible.

In the 1930's research on plant hormones took many directions. One major landmark was the chemical identification of indoleacetic acid as one of the naturally-occurring hormones. This compound had been known to organic chemists for many years. The acid synthesized in the laboratory proved to be in no detectable way different from that extracted from plants. If indoleacetic acid were active, why not other related or even unrelated synthetic compounds? Since then many plants have been daubed and sprayed with many chemicals, and the list of substances with growth-regulating activity is still being lengthened. Of these the most widely studied include naphtha-

leneacetic, indolebutyric, and phenoxyacetic acids and their derivatives, especially in the form of salts and esters. Probably the best known to the general public is 2,4-dichlorophenoxyacetic acid, or "2,4-D." Other substances are known which affect the growth of plants but are not considered to be hormones because they are not transported throughout the plant body.



Courtesy Brooklyn Botanic Garden

Geranium cuttings about three weeks old. Cutting on the right was dipped in hormone powder before putting in sand; cutting on the left not treated.

In the course of investigations of plant responses to hormones it was soon found that bending of shoots is only one of many diverse reactions. Of great practical importance was the discovery that a number of synthetic chemicals stimulate the formation of roots on cuttings. It is not yet possible to induce roots to form on every kind of cutting; but with the right substance applied in the right way, cuttings of many plants will produce longer, more abundant roots in a shorter time than they will without such treatment.

By means of appropriate chemicals sprayed or dusted on at the right time we now know how to control many other aspects of plant growth to suit man's convenience. For example, it is possible by spraying to prevent the premature dropping of apples or oranges as they begin to ripen, or to make cotton plants shed their leaves and greatly simplify picking the bolls.

Large numbers of backyard gardeners have used selective herbicides or weed killers which are fatal to broad-leaved plants such as most of our troublesome weeds and relatively harmless to grasses. The hormone type of weed killer, such as 2,4-D, travels throughout the plant and kills even the remotest roots of a susceptible plant. This makes it easy to obtain a weed-free lawn.

Many of the plants that grow in temperate climates have a period of dormancy that sets in in late summer and lasts for weeks or even months. During this period even the most favorable growing conditions will not induce lilac or apple buds or the eyes of a potato to sprout. Sometimes, as in the case of potatoes, the dormant period ends after a certain time has elapsed. In other cases the buds must be exposed for a sufficiently long time to temperatures below about 40° Fahrenheit, although not necessarily below freezing. After the chilling requirement has been met, the buds will open whenever they are exposed to good growing conditions.

This peculiar cold requirement saves many a tree from leafing out during a January thaw; but erratic spring weather may bring enough warm, sunny days to start the growth of fruit tree buds and then later a cold snap that kills the blossoms and ruins the year's crop. The use of hormone sprays in this situation is still in the experimental stage; but there is reason to hope that in such regions a grower can soon spray his trees with chemicals that will prolong dormancy until the danger of frost in his region is past.

In regions with mild winters the opposite problem may arise. For example, in certain California valleys, foggy days in winter keep out the warm sunshine and hold down the temperature. An exceptionally sunny winter may be warm enough so that the dormancy of fruit trees is not completely broken, and buds open slowly and erratically, and some not at all. In such cases one of the non-hormonal chemicals can be used to substitute for a part of the cold exposure and bring about normal full leafing out and blossoming.

Another practical use for plant hormones is to increase the number of tomatoes produced in the hot-house in the wintertime. The original hope was to produce seedless fruit by using hormones to stimulate growth of the ovary without benefit of pollination and hence without the development of seeds. It is possible to produce such seedless fruit; but, at least up to the present, they are not generally available on the market.

Research in this direction took an unexpected turn about ten years ago when it was found that hormone sprays are highly effective in increasing the number of tomatoes formed at times when pollination is inadequate to ensure a heavy and hence profitable crop. This situation often arises in greenhouses during the dark days of early winter when tomato plants may bloom freely enough but pollen

Courtesy C. W. VanHorn

Shortening the dormant period of pecan trees. The tree on the left, not sprayed; buds opened about March 20. The tree on the right, sprayed four times in February and March with dormancy-breaking chemical; buds opened about March 7.

is scanty and often defective. As a result many blossoms remain unpollinated, or inadequately pollinated, and drop off without setting fruit. It may be that the growth substance merely prevents the blossoms from falling, and so long as they stay on the plant they will continue to develop into fruits; or the process may be much more complex than that.

Simple Class Experiments

Some of the ways in which growth-regulating chemicals act can be shown by simple laboratory demonstrations. Cuttings of yew, holly, or boxwood will develop roots one to three weeks sooner if the cut ends are dipped in a hormone powder such as Rootone, Quick-Root, StimRoot, or other proprietary preparation. Faster-rooting cuttings such as those of chrysanthemum, fuchsia, geranium, or coleus show clear-cut differences between treated and untreated plants after about three weeks in the rooting medium at ordinary room temperatures.

If a regular cutting frame is not available, a satisfactory substitute can be devised from a large, flat flower pot of sand. To provide a constant supply of moisture for the fast-drying sand, plug the hole in a small, porous clay pot with a tightly fitting stopper, sink the pot to its rim in the sand in the center of the larger pot, and keep the inner pot filled with water.

If facilities permit growing tomato seedlings to blooming size and larger, seedless fruits can be produced by spraying the flower clusters with a solution, prepared according to directions on the package, of Fruitone or Seed-less-Set applied with any small atomizer. Removing stamens as blossoms open and before they discharge pollen will assure that fruit develops without seeds. A larger number of fruits are usually set per sprayed cluster, and the ovaries enlarge more rapidly than those of equivalent pollinated, unsprayed blossoms. The writer finds that plants from seeds (var. Rutgers) started in the greenhouse in late September bear their first open flowers about Christmastime, and the first fruit ripens in late March.

To demonstrate the delay of leaf-fall or abscission by chemicals, twigs of broad- or needle-leaved evergreens may be brought into the laboratory. Branches which are dipped in a solution of one of

Effect of 2,4-D on grass and on broad-leaved plants (mustard here). Pots at left untreated; at right treated. Top, at time of spraying. Center, two days later. Bottom, two weeks later. Notice that the grass has grown in both pots, the mustard died in the treated pot.

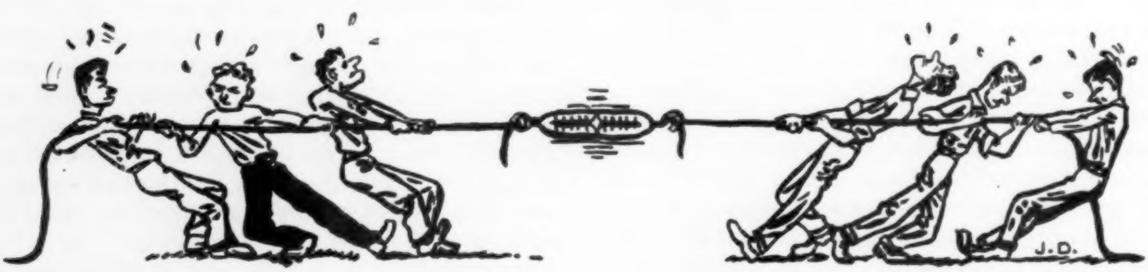
Courtesy Dow Chemical Company

the fruit-set preparations will retain their leaves or berries longer than untreated branches. The difference is exaggerated if the stems are not placed in water but laid dry on a table. Hemlock and holly are good materials for such an experiment.

Another simple demonstration will show how a weed-free lawn can be obtained. Pieces of weedy turf containing both grasses and broad-leaved weeds such as dandelions or plantains, allowed to grow until well established and vigorous, will respond as strongly to spraying with any of the large number of 2,4-D-containing weed killers as the sample shown in the illustrations on the right.

The illustrations accompanying this article are from *Hormones and Horticulture* by George S. Avery, Jr., Elizabeth B. Johnson, Betty F. Thomson, and Ruth M. Addoms, published by McGraw-Hill Book Company, Inc., in 1947.

CORRECTION: Through an error, credit for illustrations with the article on "Using the Laboratory To Develop Critical Thinking" by Gordon M. Dunning (March issue) went to the author. Frank Shaffer, a student at Indiana, Pennsylvania, State Teachers College, should have received credit for the drawings.



The two tug-of-war teams are each pulling with a force of 575 pounds. At what number does the indicator of the spring balance point? Jim Davis of Lower Merion Senior High School, Ardmore, Pennsylvania, offers this idea for use by opaque projection as a quiz item in physics.

"Conservation Education In American Schools"

A Review of the Twenty-ninth Yearbook of the American Association of School Administrators

For years discussions of conservation education have almost invariably ended with the hope that some day a sound philosophy in this field and good moral support might be forthcoming from the school administrators. In a way, the current yearbook represents a millennium since it is concrete evidence in the form of a printed book that this influential group has "seen the light" and is ready for action.

As stated in the foreword, the present effort is not a textbook on conservation or a compendium of technical information about conservation practices. It might be added that neither is it a series of digested and tried lesson plans for advancing any one philosophy to the total exclusion of others. As is stated, it is an administrator's guide, which, it is to be hoped, will eventually lead to the preparation of material which will implement the philosophy in widely separated areas with groups of highly varied interests. If it does not, the yearbook will have failed. If it does, it will have succeeded. To the reviewer there seems little doubt that it will stimulate action with a most influential group. Probably the yearbook will not meet conditions that may evolve in another decade, but it should help meet them as no other book as yet has done. It is a distinct challenge to teachers, administrators, textbook writers, and to organizations interested in conservation as such.

There is possibly some justification for the fear-for-the-future philosophy enunciated in the initial chapters. There is precedent for this, and it is in style. It may be the only method of arousing support, but the reviewer would have been happier had less space been given to the pessimistic side of the conservation philosophy and more to pointing out how our natural resources can, in part at least, be increased. The program is designed for use by youth, but it is written, for the most part, from the adult viewpoint. The writer believes that the optimistic, constructive approach might offer greater appeal to youth, but this may not be so. Unquestionably, adults influence what youths think, in schools at least, and the pessimistic approach may thus be appropriate for arousing adult support.

Certainly no one can complain that conservation education has not had the support of national groups in the last few years. Administrators who question this should read pages 230–231 of the yearbook.

While chapters of the yearbook are devoted to problems supposedly appropriate in rural schools and to those significant in city schools, it would seem that, for the most part, the committee feels that the strategic responsibility rests with the managers of the land. It would seem to this reviewer that responsibilities are, to some extent, uniquely urban. Twenty items picked at random from the recommendations for city schools were of almost wholly rural application. City children do not cut timber, let land lie fallow, drain swamps, or remove plants from fertile soil. These ideas are developed in the city recommendations. City children do waste heat, water, food, energy, clothing which they have not produced through their own efforts. These are not emphasized in the city program. It would seem that the recommendations for urban school activities might well call attention to urban responsibilities, unless the program is to be one of reading about what the other fellow should do. This the yearbook committee obviously would oppose.

It is impossible for any committee to cover adequately the whole field of activities in a program of the scope of conservation education. While good summaries are given of the programs in such states as Michigan and Wisconsin, almost no mention seems to have been made of the splendid work in Ohio. Missouri surely is not adequately represented, and we hope that the report on New York

Conservation Education in American Schools. Twenty-ninth Yearbook of the American Association of School Administrators, a department of the National Education Association. 528 pp. $4. The Association. Washington. 1951.

on page 173 is not seriously considered as representative of the work in that state.

It is regrettable that so little emphasis was given to the problems of training teachers in service, particularly when it is admittedly so important to implement without delay a philosophy of such practical importance to all of us as is conservation.

We have called attention to some weaknesses which seem to appear in the yearbook, but with no wish to imply that the effort is not of major importance. It is doubtful that anything in print on the subject is better, and a serious competitor in the near future is not likely. The book is written for administrators, it has the ammunition they need, and it should stimulate them to constructive work. Now something is needed that will help the teachers and pupils similarly. The appendix contains excellent material that alert administrators can use. For the most part, it is properly classified, and, while there are a few unfortunate omissions, the suggestions on the whole are helpful. Some further elaboration might have been made of ambitious programs that have been sponsored by the National Wildlife Federation, the American Nature Association, the National Audubon Society, and the Izaak Walton League. Most of these organizations have active local groups that might be called on for assistance in developing a program. Their contributions to the present status of conservation education entitle them and their kind to more consideration than they happen to have been given, particularly as they are all non-commercial organizations of the service type. In spite of this comment, it is doubtful whether one could easily find elsewhere a better over-all picture of the groups that have tried to help advance conservation education.

A chronic weakness of most yearbooks, namely that they show evidence of having been produced in a relatively short time to meet a deadline and, therefore, of having overlooked many good angles of the situation, is evident in this yearbook, but to a less extent than in other yearbooks on the subject. While the philosophy presented is in general orthodox, the committee, in a number of instances, has advanced the thinking of others. They see conservation, as did Leopold, as a "state of harmony between men and land," thus taking us beyond the cold efficiency of the wise-use definition. They recognize that conservation cannot be limited to natural science or to social science or to any science, for that matter. They almost said that it is applied science in general education. They do not avoid specifics, but they do not expect specific recommendations suitable for one locality to be appropriate everywhere. They struck a nice balance between the two extremes. A further evaluation of this splendid yearbook is given on the following pages.

E. Laurence Palmer
Cornell University
Ithaca, New York

Trail Riders Plan Wilderness Expeditions

Thirteen summer expeditions to the West have been scheduled by the Trail Riders of the Wilderness of the American Forestry Association. Although Trail Riders of the Wilderness was organized in 1933, it is a vacation possibility little known to most persons. More than 1700 men and women have participated in 102 separate expeditions which have explored more than 11,000 miles of wilderness trail. Parties are kept small, usually around 20 persons, and are outfitted by expert guides and packers.

The following trips have been scheduled:

Pecos Wilderness, Santa Fe National Forest, New Mexico, June 4–15, and September 4–15; Olympic Wilderness, Olympic National Park, Washington, August 20–September 1; Cascade Crest Wilderness, Snoqualmie and Columbia National Forests, Washington, August 13–25; Flathead-Sun River Wilderness, Montana, July 5–27; Sawtooth Wilderness in the Sawtooth and Boise National Forests, Idaho, July 24–August 7; Maroon Bells-Snowmass Wilderness of the White River and Gunnison National Forest, Colorado, July 24–August 2, and August 7–16; The High Sierra of California, August 29–September 10; Questico-Superior Area in Minnesota, July 10–19, and July 22–31.

The association operates the expeditions on a non-profit basis as part of its educational services, the riders sharing equally in the costs of the trips. Costs range from $170 to $205.

For trail expeditions riders must provide their own sleeping bags and air mattresses, clothing, and personal equipment—all of which must be adaptable for horse packing. Each rider is limited to a pack not exceeding 50 pounds. For the canoe expeditions weight of packs is also an important factor since packs are carried by the riders over the portages, but pack sacks, blankets, ground cloths, and air mattresses are supplied by the outfitters.

Detailed information concerning the expeditions may be obtained from the American Forestry Association, 919 Seventeenth Street, N.W., Washington 6.

Implementing The Conservation Yearbook

By E. LAURENCE PALMER

Professor of Nature & Science Education
Cornell University, Ithaca, New York

When one thinks of nature study and outdoor education, he is almost compelled to think of E. Laurence Palmer. Also synonymous with Dr. Palmer is the *Cornell Rural School Leaflet,* now in its 44th volume; Dr. Palmer has been its editor since 1919. A prolific writer, his articles this year exceed 500 in number. His latest major work is *Fieldbook of Natural History* (McGraw-Hill, 1949).

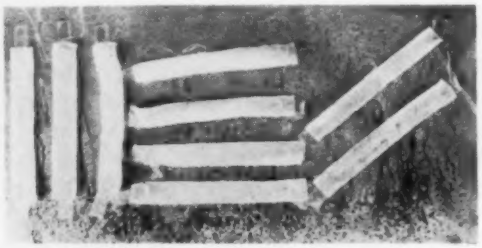
Dr. Palmer has been actively associated with science teaching societies for many years, particularly the American Nature Study Society, the National Association of Biology Teachers, and NSTA. He was president of the NEA Department of Science Instruction (forerunner of NSTA) in 1929. Director of nature education for *Nature Magazine* since 1925, Dr. Palmer was recently appointed director of conservation education for the National Wildlife Federation.

With all this background what could be more natural than to turn to E. Laurence Palmer for a review of the new superintendents' yearbook and for an article suggesting ways of implementing the yearbook in the classroom?

In some ways this yearbook might seem to serve as a green light to timid administrators who hesitate to lend their support to conservation education for fear that they might be "different." With excellent skill the committee has presented the dramatic situation in which American economy finds itself so far as our natural resources are concerned. It does not hesitate to draw valid conclusions relative to the deterioration of civilizations in Europe, Africa, and Asia due to abuse of the natural wealth available to them. All of this is fine, but it would seem that we need a few real suggestions as to what any teacher can do to convince children that there are important differences in their immediate environments today that help or interfere with their happiness and welfare and that may be modified by human behavior. Used with caution, the working of the major factors of conservation may be simulated by simple experiments in any classroom. These simple experiments should provoke convictions that should lead to a more rational behavior than might result from reading about exotic phenomena.

Let us take the simple story of soil erosion that is recommended as a part of a conservation program. True, we have spectacular wind and water erosion in the great plains or almost anywhere in the open country. But can the teacher get the children out to see such erosion in action? This can be done with no trouble whatever. Almost any schoolroom window is basically hard inorganic material. On most such windows is dust, deposited by wind. What better example of loess could one get from a scientific supply company? When it rains, water strikes the window, and, since the slope is really steep, a violent erosion soon washes the window free of dust, leaving beautiful little gullies for anyone to see. How can the role of strip cropping be more simply demonstrated than fastening some strips of cloth to the outside of the window with some adhesive tape, placing some of the strips horizontally and some vertically? Between the vertical strips spectacular miniature gullies will form, but none will form where the movement of the water is stopped by the strips "on the contour."

If the window is a storm window suspended from the top by hinges, it can be swung to different angles, and the effects of slope may be demonstrated. If the window is covered by a wire screen, the rain drops, broken into smaller drops before they hit the glass, will do less erosive damage than would the larger drops. Trees and other vegetation are effective in interfering with erosion in much the same way. Almost invariably a greater accumulation of materials can be found at the bottom of any window than at the top. The eroded material has to accumulate somewhere. Any teacher can show this fact to a child on a windowsill, while a visit to a lowland may not be possible to see the vast accumulations of silt that may or may not be available. Examination of almost any eave-trough or street ditch should suggest lessons in erosion and other lessons on what happens when waterways are dammed. You don't have to go miles to see effects that may be evident, possibly in smaller degree, a few feet from where you sit.



A window erosion laboratory with "strips" on the contour and otherwise showing gullies formed on the up and down hill cultivation. Controlled study leading to significant inductions is readily accomplished with this laboratory. Broad applications can be made.

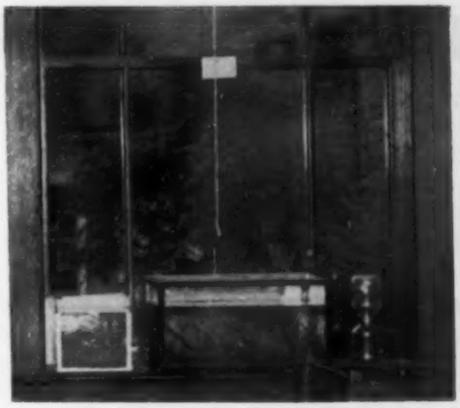
In its sections on grasslands the yearbook tells how federal agencies control activities on such areas. A bit of grass a foot square on any lawn may illustrate satisfactorily the principles that make the great grazing lands of the world possible. It is better for a child to stand on a lawn laboratory, to explore what makes the lawn possible, to feel with his hands or his feet how it differs in temperature and humidity from the paved deserts of our sidewalks, and then to draw conclusions from what he sees and feels than to read about such things in a book. The yearbook advises against over-use of books, but again and again suggests that we read about this or that. The writer feels some resentment for the statement on page 119 that the so-called nature study program consists largely of material obtained from books. To him, this has not been the case. Certainly more elementary science programs have been based on books than is the case in nature study. If one studies nature, he should find fewer errors of fact than are to be found in the average elementary science text. Let's get our conservation education from realities. The

A good laboratory for studying hydraulics, frost erosion, water erosion, and water table. Children have been known to work in this laboratory after school hours.

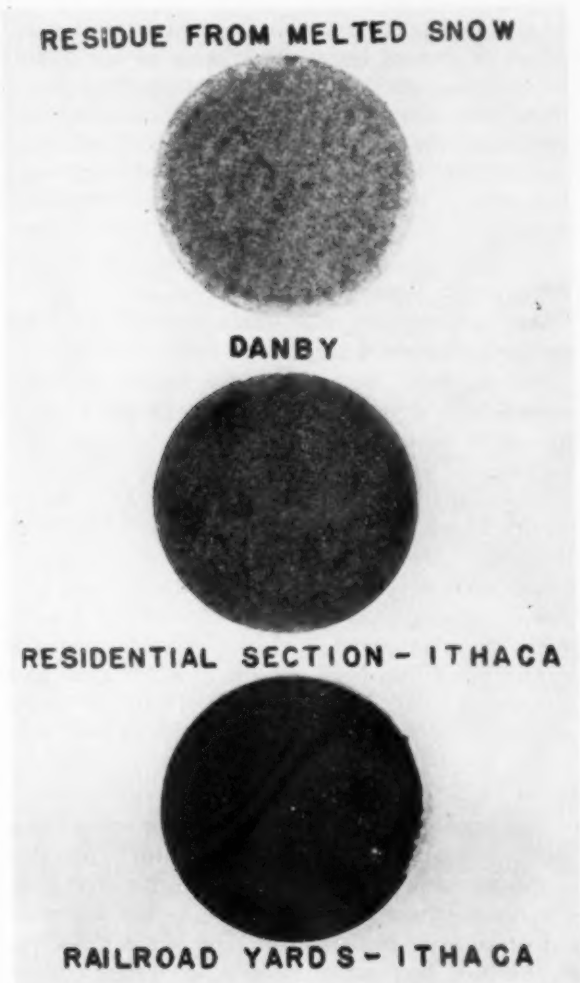
lawn is our example of grasslands; the sidewalk, of a desert or wasteland. A single tree or shrub can illustrate most of what a forest can show us and may be considered a wooded laboratory. If we want to study wildlife and observe responses to management and to the physical nature of environment, flies on the schoolroom window have some real lessons for us, and they cost nothing in money or effort. A couple of glass jars fastened together by their perforated metal tops can be a little weather machine in which we can control light, temperature, humidity, and other factors that influence wildlife. We can cut a day to a few minutes by putting one bottle in darkness, while the other is in light. With cold or hot water bottles we can chill or heat the little area and see what happens to the organisms confined in it. Even in the largest city, we can manage a bit of environment and can get facts useful in understanding the major problems of conservation. When dealing with little folk, let's use little climates. By putting a bit of damp blotting paper in a bottle, then placing a hot water bottle under it and a cold water bottle above it, little cold fronts adjacent to

warm fronts can be created and children can see and feel with eyes and hands what happens when warm, humid air comes into contact with cooler air. Instead of talking about the weather, we can make weather, and by studying it, we can understand why the weather varies in different parts of the world and why and how this affects the prosperity of organisms living in different places. It was a bit disappointing that the yearbook did not make a few suggestions along this line, but possibly this was not appropriate in the minds of the committee.

The story of pollution holds many opportunities for simple experiments, some of which call for little or no travel. Have children bring to school snowballs made from snow taken from the upper inch of a snowbank. Put a paper towel in a funnel and drop the snowball inside the towel. When the balls have melted, dust and dirt that may have fallen from the air onto the snow will be left as dark spots on the paper towel. Comparing the darkness of the spots may show that the air everywhere is not equally pure. This may start worthwhile thinking about air pollution.



A window laboratory with a home-made terrarium, an aquarium, and the home-made "weather machine" in which one can make little climates, study tropisms, and demonstrate the effects of warm and cold fronts.



Courtesy H. S. Fowler

Demonstration of air pollution.

Children who live near a waterway that flows through a city may bring quart fruit jars of water to use as aquaria. If some samples come from above and some from below where the city's pollution contribution is made, comparisons may be made as to how long goldfish of equal length will live in the two samples of water.

The yearbook presents some good information on school camps, with particular emphasis on those of the Kellogg Foundation. It is a bit disturbing that little attention was given to the techniques of survival which must be mastered by many youths before they reach voting age, and possibly, in case of a catastrophe, by all of us. Would not a bit of guidance on where to get help on survival methods have been welcomed, to carry further the somewhat academic programs usually found in organized camps? Living outdoors is more than picnicing. Sleeping bags enough for a class might be a more practical investment, so far as teaching "harmony between men and land" than all the books in a library, or all the fancy cafeteria-equipped camp buildings in the country. At any rate, this subject is worth thinking about in these times of world stress, and might lead to the conservation of at least a few of those who will be carrying the burden of our civilization under most trying circumstances.

FOUNDATIONS, INDUSTRY, AND EDUCATION*

By Vice Admiral HAROLD G. BOWEN, USN (Ret)

Executive Director, Thomas Alva Edison Foundation
West Orange, New Jersey

PERHAPS I can begin with an over-simplified statement by saying that the progress made by any civilization is a direct result of the creativeness and originality of the sum total of the individuals who make up that civilization. We can see also, from a study of history, that a free society which provides the maximum incentive for individual expression makes the most significant contributions to world progress.

We know that our American industrial growth was largely initiated by men who were self-educated, and their original solutions of many problems reflect the importance of invention in all fields.

However, we must raise the question whether our present-day educational system is fitting the glove of formal education too tightly. Certainly educational opportunities in a democracy should be available to all, but we also must remember that, within our school curricula, we should develop teaching methods that do not restrict the teacher to teaching to the lowest common denominator. Individual motivation is a key point in considering methods and curriculum to be employed in education.

Now when one begins to study the life of Thomas A. Edison, he finds that "the Edison method" is actually a method of making invention. As a method it was first described by Roger Bacon; but because of the tremendous success of Mr. Edison in applying it, it has become known as the Edison method. However, one is amazed to discover that it is not only a method of making invention, but, what perhaps may be vastly more important, it is a method of self-education.

Edison had about one year of formal education. He simply did not fit in with the type of education which was current at that time in the United States. His mother, instead of trying to compress her son into orthodox ways of thinking, encouraged him to continue his experiments and his original and youthful ways of approach to life. She obviously interposed no objections to, for instance, his experiments in chemistry and electricity. The net result was that she had encouraged his sense of originality, founded on his lack of imitativeness, to such a degree that by the time he was 14 years old, he was, to all intents and purposes, self-supporting.

Somehow or other Edison evolved a technique which most of us have to go to universities in post-graduate courses to acquire. His success was due to those qualities which we have described; and we must come to the conclusion that there is hardly any individual who, by hard work and application, cannot become a success in life if only he can discover what he has adaptability for. I think our education today does not sufficiently emphasize the necessity for individual effort. Education may well strive to emphasize, with each individual, the importance of the individual. Schools have to teach facts. But we must get behind these facts and tell the pupils how these great men made their contributions. The important thing is *how* these individuals worked and *what methods* they used to achieve their success.

We are living today in the midst of a phenomenon which it is appropriate to call the modern industrial state. We know of the obvious importance of education to industrial progress. We also see that our industrial growth has created wealth which gives us the leisure time to apply to thinking. Also, we know that eleemosynary foundations have historically gained their positions due to the originality and resourcefulness of managers of commercial activities that created the wealth which has been applied in an original and pioneering way in the establishment of many private philanthropic foundations with various purposes. Needless to say, education is the chief interest of the largest percentage of foundations.

The profusion of foundations as we know them today is a product of the 20th century and due to the accumulation of capital which resulted from our development and emergence as the foremost industrial state in the world. The late Mr. Edwin R. Embree had many interesting things to say

* Based on a talk given before a joint session of the AAAS Science Teaching Societies, December 29, 1950, Hotel Statler, Cleveland, Ohio.

"Son of Providence, product of its schools and the United States Naval Academy with post-graduate study at Columbia and the Naval Post Graduate School at Annapolis. Notable innovations with high pressure, high temperature steam; valuable experimentation in power systems, particularly turbines; pilot operations for the concentration of fissionable materials; contributions to the refinement of radar; all these manifest a versatile and inquiring intellect, and give you distinction in a distinguished service."

So read the citation when, in June, 1947, Brown University conferred the honorary degree of Doctor of Science upon Vice Admiral Harold Bowen, then recently retired after 40 years in the service. Important posts held during his long career include those of chief of the Bureau of Engineering and engineer-in-chief of the Navy, director of the Naval Research Laboratory, and special assistant to the Under Secretary of the Navy.

However, the human qualities and the wisdom of "Hal" Bowen are hardly apparent in these formal biographical notes. This condensation of his Cleveland talk will give you some insight into his philosophy and wealth of knowledge. And 100 or so classroom science teachers will meet and talk with him in person during the forthcoming Edison Foundation Institutes.

about foundations. He has raised some very challenging questions.[1] The fact that he was a vice-president of the Rockefeller Foundation, president of the Julius Rosenwald Fund, and president of the Liberian Foundation should make us thoughtfully receive his comments.

Mr. Embree records that, in 50 years, medicine and public health have progressed to the point where, today, American medical education leads the world. This progress in medicine and public health is perhaps due largely to efforts of the Johns Hopkins Foundation and the Rockefeller Institute for Medical Research. He also cites the work of the Rockefeller Foundation in establishing the University of Chicago.

Speaking of today, Mr. Embree felt that there are not "comparable instances of creative attack on basic problems." He felt that there is, at present, a lack of pioneering. Mr. Embree states further: "America has developed good professional training in medicine, law, and engineering. We have sadly neglected preparation for the most important profession—teaching. The need is not for more or bigger normal schools and teachers' colleges. God forbid! The need is to find and demonstrate sound and realistic preparation for a great profession. The improvement in medical education indicates the profound influence a foundation can have. One of the clearest and greatest opportunities today for private enterprise in philanthropy is in showing the way to make teaching the magnificent profession it must become if America and democracy are to grow to full stature."

The Thomas Alva Edison Foundation is a novel organization in many respects. It is a discretionary type of foundation and, as an operational organization, has not made any grants to date. It was not founded by Thomas A. Edison but by men and corporations who are interested in perpetuating the work and ideals of Mr. Edison. It is believed that the Edison Foundation's purpose can best be served by developing programs that will influence the future and not solely restrict attention to recording and glorifying the past. We do not intend to restrict ourselves to narrow purposes. We can perhaps add to our advancing standard of living by discovering and bringing into production those young Americans who radiate creative and original thinking.

The Thomas Alva Edison Foundation is at the present time considering a plan, carefully worked out with the cooperation of the National Science Teachers Association and the United States Office of Education, to implement the ideas I have discussed above.

The proposal being considered by the National Science Teachers Association is primarily based upon a philosophy that will stir the public to doing the sort of thing in schools that will bring about the initiative to develop the full potentialities of each individual. It is believed that teachers have to change generally the nature of their instruction from stereotyped group instruction to a type of instruction that will give more attention to the individual.

Statistics of the U. S. Office of Education show that more than 50 per cent of those entering high school will leave before graduation. Also, in this age of science and its demands on creativeness and originality, less than one-half of the high schools offer chemistry or physics in any one year.

Leaders in education have emphasized the need for individualized instruction, but the mass-edu-

[1] Embree, Edwin R. "Timid Billions—Are the Foundations Doing Their Job?" *Harper's Magazine*. Vol. 198. No. 1186, March 1949.

cation emphasis finds most teachers unprepared to use even currently available methods and materials that recognize individual differences. The Thomas Alva Edison Foundation considers that there is a fine opportunity for pioneering work in establishing some means to translate this fundamental thinking into action.

The Edison series of Science Teacher Institutes would be a direct approach to classroom teachers. The emphasis would be on bringing to light the best practices for encouraging native inquisitiveness, effective methods for developing the pupil's powers of careful observation, techniques for implementing creative experimentation, and skills for bringing about fruitful reading. What is known about such emphases and how to utilize such ideas in schools would be shared with others in each institute, and the participants would in turn share their enthusiasms and know-how with local associates when they return to their own regions and school communities. The best ideas and the ablest teachers in their use would be brought together in a national institute where the proposals from regional groups would be evaluated. No agency is now reaching classroom science teachers through regional and national institutes.

Thus, one of the chief educational interests of the Edison Foundation should be to focus attention on the latent potentialities in individuals of the nation. The goal is to arouse them to purposeful individual activity so that the opportunities in schools, homes, and communities may be wisely used for self-education. The belief is that such talents are widespread and that some method of discovery and invention in teaching methods can be devised to stimulate and guide these talents.

Please know that when I discuss education I speak, I hope, with becoming diffidence. I have never taught. After graduation from the Naval Academy and after the conventional six-year cruise, I was ordered ashore to the Naval Academy to become a teacher at that location. Fortunately, I was able to convince the Bureau of Personnel that it would be much better if my orders were changed to duty at an industrial Navy yard.

I never liked the Naval Academy. In the first place, I couldn't study as much as I wanted to nor as much as I needed to because of the complete regimentation of my life. I met but two *teachers* at the academy. You simply went to the desk of the so-called instructor—generally a Naval officer and sometimes a civilian—and drew a question and with all possible speed attempted to put on a blackboard a convincing argument that you knew the answer to the question.

My experience in post-graduate engineering was entirely different. I met, both at the Navy PG school at Annapolis and at Columbia during the second year, some really remarkable educators. This was the first year of the real Navy PG School: one at Annapolis, the following year at a university. For our first year at Annapolis, almost all the professors were from Harvard, Columbia, and Michigan—and what a galaxy of brains! I had long felt that there was something missing in my educational life, and this experience proved it. Since memory is an inherited and not an acquired characteristic, I am very much against any such system of rating young hopefuls, whether they are destined for the Navy or for civilian life. The Naval Academy has no interest in deductive or inductive reasoning or originality.

We hear a great deal about the lack of interest of students—in high schools particularly—in the serious subjects of, for instance, physics and chemistry and engineering. Referring again to my own experience, which may or may not be outdated, children in their formative years are not exposed enough, if at all, to factual education such as industry can supply. In my life-long attempt to acquire an education, I cannot think of anything I missed more, in my formative years, than the opportunity to visit plants to learn something about the interesting processes right in my own backyard. I wish there were some way that children at the right ages could witness surgery in hospitals, trials in courts of justice, research in laboratories, and operations in industrial plants in order to broaden their horizons and to give them factual evidence about the various vocations of man which otherwise are nothing but words in their vocabularies.

A foundation should pioneer in new ways to better education—in fact, to do some original thinking. The amount of education a person needs is steadily increasing, and it is admitted that all sorts of shortcuts must be used in order to cover the required educational ground within the conventional period. I think this can be done in part by the use of supplementary literature, and I do not know of any better sources for such supplementary literature than foundations, industry, and the nearest industrial plant. Industry needs this support from our young people if for no other reason than that industry needs more and more young engineers and scientists.

I have particularly called your attention to the fact that present-day foundations are, in general, being criticized because it is felt that they have lost the pioneering instinct. They are supporting con-

Committee on Apparatus and Equipment

The NSTA Committee on Apparatus and Equipment operates on the assumption that good science teaching centers around the use of sufficient suitable apparatus and equipment. Our purpose is to compile and disseminate information relating to the best and most practical apparatus and equipment for modern science teaching. Thus far the committee has completed one major project and has provided two exhibits for national meetings.

The evaluation of new and existing apparatus and equipment. In the report of the committee's first project, in the October, 1950, issue of *The Science Teacher,* it was pointed out that at least one-third of the money spent on test tubes can be saved by substituting borosilicate tubes for the ordinary soft or sodaglass tubes. Other fact-finding projects similar to this one are being undertaken and will be reported on in due time.

Exhibits of science-teaching ideas. The committee provided exhibits of student- and teacher-made devices and gadgets for the two most recent winter meetings of NSTA in New York and Cleveland. At these meetings probably more interest was shown in action exhibits than in any other type. By an action exhibit is meant one in which the observer pushes a button or otherwise makes certain manipulations in order to obtain the answers to questions.

At Cleveland there were several excellent examples of action exhibits. Norman R. D. Jones displayed an electrical state-bird identification board. By connecting the proper contacts, one can find the official bird of any state. Gordon M. Dunning displayed a color addition mechanism of simple construction. By snapping one, two, or three switches, one can learn the individual primary colors or any combination of them. Margaret Patterson exhibited a remarkable collection of pictures of science fair and science talent search activities.

The committee can function only with the cooperation of NSTA members. Any suggestions for future action of the committee will be most welcome. Answers to such questions as the following are desired:

1. What apparatus and equipment evaluation projects can you suggest?
2. What exhibits can you provide?
3. What is the best action exhibit you can prepare for the December, 1951, meeting of NSTA? (The 1951 meeting will be held in Philadelphia.)
4. What pet idea or gadget would you like to commercialize? The committee may help you find a sponsor.
5. Have you an idea for a simple home-made apparatus you can write up for *The Science Teacher?*

All teachers who would like to participate in the work of this committee may become consultants to the committee by sending their names to a member of the committee. Prompt action is urged. We need participants in the projects now being organized.

Members of the committee include: Walter S. Lapp, Lansdale, Pennsylvania, chairman; Earl R. Glenn, Upper Montclair, New Jersey; Millard Harmon, Auburndale, Massachusetts; Norman R. D. Jones, St. Louis; Ralph W. Lefler, Lafayette, Indiana; Morris Meister, New York City; John G. Read, Boston; Wayne Taylor, Denton, Texas; and Elbert C. Weaver, Andover, Massachusetts.

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ventional education, yes; but they are not supporting attempts to find out ways and means to improve education and teaching, i.e., they have lost their capacity for original thinking.

I think there is a wonderful opportunity to personalize and color the teaching of science in our schools in order to build up a greater interest among prospective engineers and scientists—and among students not majoring in science, as well. I think we need to talk in our schools far more about the history of science and technology and the wonderful story about these subjects as recorded in, for instance, Professor Butterfield's book.[2]

The Thomas Alva Edison Foundation hopes, by working with the National Science Teachers Association, to develop methods whereby more color, personality, and individuality may be displayed in the teaching of science which will thereby provide for a climate for discovery and invention. Education's prime job should be to train people to think. If the motivation which first manifests itself by curiosity can be analyzed, seized upon, and nurtured, it is very likely that educators can be rewarded by knowing that they have participated in the development of original and creative ideas which, when put to the test of "consumer" (public) acceptance or rejection in a free society, will redound in the further creation of wealth and *time to think* and a resultant constant progress forward of our western civilization.

[2] Butterfield, Herbert. *The Origins of Modern Science.* G. Bell and Sons, Ltd. London. 1950.

Without a comprehensive and practical program of conservation supported by the people, our nation cannot hope to retain the position of world leadership it has today. Unless effective methods of conservation are generally practiced, it will be impossible to maintain the present standard of living in this country.

New Jersey Emphasizes Conservation for Teachers

By **ROBERT H. MORRISON**
State Department of Education
Trenton, New Jersey

CONSERVATION IS BASICALLY a problem of education. It is the responsibility of the schools to see that the youth of our nation have the necessary knowledge about conservation. However, far too many teachers do not have the knowledge, experience, or attitude to deal adequately with the subjects of conservation. Because of this, the New Jersey State Departments of Education and Conservation in the summer of 1949 jointly established a School of Conservation for Teachers. The purpose of the school is to help teachers and other community leaders understand that the conservation of human and material resources is one of our most urgent needs. The school emphasizes that soil erosion, forest fires, lessening of the water supply, waste of minerals, and wanton destruction of wild life are endangering our future. It then teaches what can be done to better the situation.

The school is located on the shores of Lake Wapalanne in Stokes State Forest in northwestern New Jersey. This area comprises more than 12,000 acres of woods, streams, and mountains. Adjacent is High Point Park consisting of 8000 additional acres. To the east is the Kittatinny Ridge along which runs the Appalachian Trail. To the west are the Delaware River and the Pocono Mountains. There are 19 permanent buildings at the school. These consist of a classroom-recreation hall, an office building, a food service building large enough to seat 180 at one time, 12 cabins, each of which will accommodate nine persons, an infirmary, and three utility buildings.

The curriculum is planned primarily for teachers of science and for upper-grade teachers in the elementary schools. The courses are planned in units of two weeks' duration. Students may enroll for two, four, six, or eight weeks during July and August.

The following ten subjects are offered: biological field science, conservation of plants and animals, physical science field studies, conservation of water and soil, water safety and first aid, camping education, practicum in camping leadership, geology, field geography, and rural sociology. Students who complete one or more courses may receive credit in any of New Jersey's Teachers Colleges.

During the 1950 summer session the school operated a children's conservation camp to demonstrate curricular content and methods of teaching conservation. Activities of the conservation camp included the following: planting of trees, building and studying dams for water conservation, studying how to correct soil erosion, getting acquainted with wild life in the forest, building shelters for game, testing lakes for fish food, working to prevent forest fires, improving streams, building trails, and learning about woodlot management. The demonstration camp vitalizes the curriculum in conservation for teachers and offers a wealth of information to the children.

The course in rural sociology provides opportunities for teachers who were born and reared in the cities to get acquainted with families who live on farms. The college students visited the farmers and accompanied them to see the morning feeding and milking. They learned about modern methods of milking, barn sanitation, and about different breeds of cattle. They visited farm cooperatives, grange meetings, auction sales, and county fairs. They talked to the county sheriff, the prosecutor, and the judge of the magistrate's court. Through such visits they learned how important conservation is in the life of people who live on the farms and produce the food for families in metropolitan areas.

The courses offered during the summers of 1949 and 1950 enrolled students from the six New Jersey State Teachers Colleges, from Panzer College, and from Fairleigh Dickinson College. The majority were undergraduates. A substantial number were teachers who were working for a graduate degree. Many of these young people were born and reared in metropolitan communities. Many of them knew little or nothing about farm life and conservation. They came to the School of Conservation unaware that rich top soil and adequate water are both fundamental for our present and future development. A large percentage did not understand the seriousness of soil erosion, and those who did understand it did not know how to teach children to work in restoring their heritage of natural resources. After completing their courses and working with the children in the conservation camp, they returned to their classrooms with new understandings and a new zeal to teach children to conserve.

Teachers from the colleges and experts from the Conservation Department constitute the faculty at the School of Conservation. State foresters teach how to conserve trees. The state fire warden explains and demonstrates what can be done to prevent and control forest fires. The university specialist in soil conservation takes the students to farms to illustrate the gains made in prevention of soil erosion. An official from the Fish and Game Bureau personally introduces the students to the wild life of the region and discusses what is being done to conserve it. College teachers integrate these special lectures and demonstrations into a functional course for the students enrolled.

Students enrolled in summer sessions at the State Teachers Colleges frequently spend week-ends at the School of Conservation. Their teachers, who have previously visited the school and studied the region, plan their summer instruction in sciences to include first-hand observation of the plant and animal life at the school of conservation. Through such observations conservation takes on new meanings, and science becomes more understandable.

During the 1950 summer session the school was host to several conferences of one-, two-, or three-days' duration. The Helping Teachers of New Jersey, the Future Home Makers, the Future Farmers, and the Camp-Fire Leaders all came to the School of Conservation and used its facilities in conducting conferences. Individuals making up these groups were eager to learn how to conserve. Their use of the School of Conservation stimulated their interest and added to their understandings.

At the School of Conservation prospective teachers and teachers already in service can gain a first-hand acquaintance with materials and methods for teaching conservation and related subjects in the schools of New Jersey. During the past two summers, more than 1000 adults participated in the program of the school—some for one day, others for six weeks. They gained basic understandings of the use of soil, water, trees, and wild-life on the farms and reservations in New Jersey. They gained a rich background of nature education, recreational methods, and an appreciation of farm families.

A quotation from Dr. John H. Bosshart, commissioner of education for New Jersey, summarizes the importance of the School of Conservation.

> A period of education away from the metropolitan areas *in a place where conservation is being practiced* will do much to help teachers become conservation-minded. They, in turn, will teach youth of New Jersey to save and to restore their natural resources. The future of the nation rests primarily on the intelligent development of the use of soil, water, minerals, forests, and wild life.

how effective are YOU

As a Teacher of Scientists?

By MARGARET E. PATTERSON

Executive Secretary, Science Clubs of America
Washington, D. C.

IF THE SCIENTISTS of tomorrow, now in your classroom, rated you as a teacher, would they picture you as: (1) PATIENT, (2) INSPIRING, (3) ENCOURAGING, (4) UNDERSTANDING, (5) STIMULATING, (6) CHALLENGING, (7) ENTHUSIASTIC, (8) COMPETENT IN YOUR SUBJECT MATTER, (9) WILLING TO ANSWER QUESTIONS IN AND OUT OF CLASS, and (10) A HARD WORKER WHO EXPECTS HARD WORK FROM YOUR STUDENTS?

These are the descriptive terms most often applied to teachers by 300 high school seniors each year for ten years when asked to: *"Name the science teachers who have been most influential in the development of your interest and competence in science. For each indicate briefly in what way they have been most helpful to you."*

The 3000 seniors, 40 winners and 260 honorable mentions in the annual Science Talent Search for the Westinghouse Science Scholarships, have revealed each year since 1942 how science teachers helped shape their science careers. They have been so consistent in their evaluations that their answers add up to a composite picture of a good teacher of scientists.

The boys and girls in the 300, selected each year from thousands of seniors because they show greatest potential for research careers in science, modify the trite saying "behind every great scientist there is a great teacher." They each give credit to not one, but several teachers for their present ability in science. Not overlooking early home influences and grade or junior high school teachers who touched off the spark now burning within them, by far the greatest number state that their high school science teachers were the outstanding influence in shaping their careers up to graduation time.

As would be expected, they are most grateful for good classroom instruction. They unanimously agree that courses cannot be too "tough" if they are taught by "alive" and inspiring teachers. The seniors praise teachers who drilled them in difficult techniques, rigorously demanded accuracy, and insisted on clear, original thinking. Especially appreciated are the teachers who could arouse students to greater effort by piquing their curiosity, throwing out challenging questions, and posing knotty problems for mental exercise. These devices, they feel, were most successful when the teacher could supply more information as the students' own resources for explanation were exhausted. Pupils liked exploring new fields and being shown the interrelation of all sciences and mathematics as a basic tool in each. They admire teachers who "know the answers" or know where to find them. Special praise goes to those instructors whose enthusiasm for science was so great it "infected" the whole classroom. It was such a teacher who caused one senior to comment, "She taught me the most important thing I've ever learned—to be open-minded. When I graduated from her class, I had a great craving for more knowledge."

In the laboratory these scientists-to-be appreciated permission to conduct personal investigations of problems that intrigued them. They laud those teachers who taught them basic methods and techniques of research: controls, how to plan, carry out, and evaluate an experiment, how to

In this article Margaret Patterson brings us the distillate from a review of the comments of some 3000 Science Talent Search entrants, finalists, and winners in praise of their science teachers. You will agree, we believe, that here are some factors worthy of serious reflection. Would you also agree that item eight in the list is "extremely important" in providing for the security and poise essential to most of the other factors?

Science Service Photo

"But most of all they valued the readiness of teachers to answer questions, talk over problems, counsel and advise them in their experimentation and study."

budget time and organize materials at hand for a sound experiment. "Try it and see" was advice that delighted them, and even "try, try again" did not discourage them when the teacher was skillful in pointing out the need for persistence in the face of failure or insufficient evidence. As one senior said, "He always made me do it myself, but he kept me going—forward."

But the influence of good science teachers extends far beyond the classroom and the laboratory, according to these 15-to-17-year-olds who have observed them so closely. They were proud when they were singled out for a working-team relationship with the teacher. If laboratories were open to them after school hours, they tried to repay the privilege by serving as assistants or otherwise helping busy teachers. Many report that these out-of-class work sessions together were the most pleasant associations of their student-teacher experience. They cite instructors who graciously loaned books, magazines, expensive equipment and apparatus, often from their own, personal possessions, or otherwise helped to get them on loan for students' aid. But most of all they valued the readiness of teachers to answer questions, talk over problems, counsel and advise them in their experimentation and study. In nearly every case this constituted an extra burden on the teacher, and the students recognized it as a sacrifice in their behalf. It was such "beyond-the-call-of-duty" helpfulness that elicited tributes like, "He has been a wonderful advisor and an understanding friend," and "She is not only my teacher but my friend with whom I can converse freely."

The teachers elected as "best" score also as being the ones who "opened doors" to opportunities in science for the young scientists. The science club comes in for many comments because there the teachers and science-professionally-minded students could go into discussions and demonstrations far beyond the class-time limitations. Others praise field trips, jaunts to nearby college campuses and industries, and other excursions under teacher leadership as times when they learned how the world of science operates.

All of the boys and girls make some reference to the chances given them to compete with others their own age in such things as science fairs, Junior Academies of Science, and in the Science Talent Search itself. They freely admit that they would not have extended themselves if they had not been "pushed" by the encouragement of teachers who recognized their ability more than they did. Teacher introductions to local or nearby scientists and faculty members of colleges and universities are hailed as a real service that gave them entrance to new associations and opportunities. Help in choosing a college and in career planning are other admitted gains. Assorted kindnesses are covered by such statements as, "I owe this and other scientific successes almost entirely to his guidance and encouragement. He kept checking on my progress and offering suggestions," or "She was my spur and my mentor," or "He made me realize I did not have to wait to do things in science. He helped me prove I could begin at once."

During this ten-year period the 3000 seniors have gone, or will go, on to know many more teachers before their foundations for careers in science are set. But that early boost during the decisive, formative years of adolescence is not forgotten as they recognize their secondary school science experience as a turning point in their whole career.

Some readers know that one or several of these 3000 were reporting on you when they wrote their comments as high school seniors. You have already known the pride beyond price that comes from helping students to recognize and develop their potential as scientists.

The world, increasingly dependent on well-trained scientists, may never give you higher praise than the gratitude of students who say, "My science teacher was an example of unselfishness and devotion to encouraging and developing each of us."

Getting Started IN THE TEACHING OF PHOTOGRAPHY

By MAHLON H. BUELL

Head, Science Department
Ann Arbor High School, Ann Arbor, Michigan

THE IMPORTANCE of commercial and journalistic photography and its popularity as a hobby have prompted an increasing number of high schools to offer courses in photography as a part of their science or art curricula. In many other schools serious consideration is being given to such a course. How to get started seems to be one of the most perplexing questions for those who wish to begin. The purpose of this article is to relate how this question was answered in one high school and to offer some suggestions to anyone who may be interested.

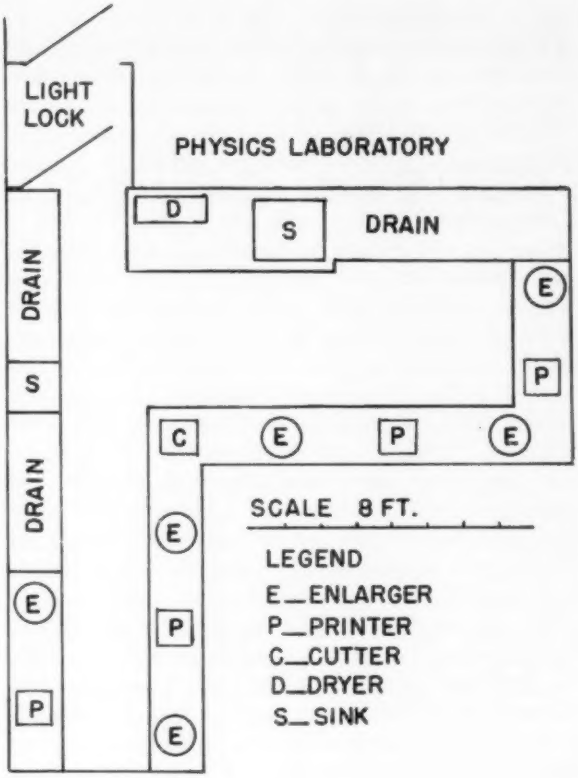
As a starting point let's assume that there is enough interest in photography in the school so that a class could be formed which would meet on regular schedule during the school day—also that full credit would be given toward graduation upon the completion of the course. The following suggestions, if considered in advance, will help to make the course more profitable and enjoyable to both teacher and pupil.

> We don't know how much "pressure" from administrative sources is exerted upon Mr. Buell. Our guess is that he could take it rather easy. But no, he is teaching three different laboratory courses: physics, physical science (as reported in the February issue of *The Science Teacher*), and photography. And our readers should see his laboratory—it is neat, clean, well-equipped, and filled with numerous "handy gadgets" of his own design and construction.
>
> "It's easy, though," says Mr. Buell. "You buy something new each year, take good care of it, and use it for a long, long time." Between Mr. Buell and his predecessor, Henry Chute, Ann Arbor High School has had only two physics teachers in 74 years!
>
> In this article Mr. Buell tells us how to get started with a course in photography. His suggestions will also prove helpful to sponsors of photography clubs.

1. The most important requirement is to have a teacher whose interest in, and knowledge of, photography are sufficient to make him want to teach the course. Usually this is a chemistry or physics teacher who is interested in the chemistry and optics of photography, as well as in its artistic aspects. Such a person will enjoy helping the enthusiastic young photographers to do better one of the things that they want to do anyway. But teaching this course is no easy job. It is much easier to take on an extra class in physics or chemistry where the course is well organized and the laboratory is well equipped than to start to teach a class in photography under the handicaps of inadequate textbooks, supplies, equipment, and darkroom facilities which most photography teachers face.

2. Second in importance is a school administrator who is enthusiastically interested in the course and who will help in every way possible to make it a success. Among the things that he can do are: provide time in the teacher's schedule for the course; give the course publicity so that students will elect it; approve a suitable budget for supplies and equipment; assist the teacher in finding suitable darkroom space and in making the necessary installations of electric outlets, shelf space, running water, equipment, and heating and ventilating facilities.

3. Foremost among the physical requirements is a darkroom. This may be only a light-tight janitor's closet where film can be loaded into tanks and where printing can be done by only two or three pupils at a time, as in one school visited by the author, or it may be an entire photo laboratory adjacent to a classroom studio as is the case at Edison Technical High School in Rochester. In some schools the contact printing and enlarging is done in the darkened physics laboratory while an

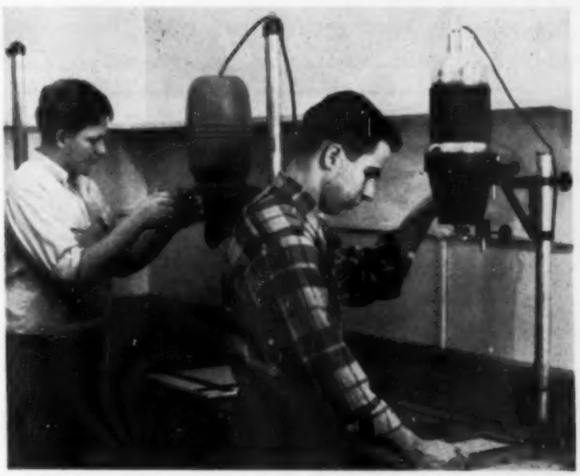


adjacent darkroom is used for film processing. The author uses the physics classroom and laboratory for class and studio purposes, has converted an odd-shaped corner of the physics laboratory into a film loading and developing darkroom, and has combined a small darkroom, a short corridor, and a part of a store-room into a printing and enlarging room which will accommodate six to eight pupils at a time. A floor plan of this remodeled darkroom accompanies this article, not because this is a model darkroom but because it shows what has been done with limited space. Fortunately the sinks and heating and ventilating system were already in place before remodeling began. In this darkroom the safelights are operated by a switch near the door while another switch controls the white lights. A permanently-connected electric clock, contributed by a local photo supply dealer, is illuminated by a red light which switches on and off with the safelights. An extension line runs from the school signal system to a buzzer in the darkroom so that pupils hear the passing signals. Of great importance are shelf space above and below the sink and working shelf, a rack for trays, and individual lockers large enough to hold a pupil's camera, paper, solutions, film, and other supplies. These lockers can be made in the school shop and designed to fit available space.

4. Essential darkroom equipment should include at least one contact printer, one timer, one film developing tank, and one enlarger, plus as many trays, ferrotype or chromium drying plates, photographic blotters, print rollers, mixing jars, bottles, stirring rods, and graduates as space and finances permit. A print trimmer and heated dryer are very convenient but might be purchased later.

5. For taking pictures, pupils should furnish their own cameras. These probably will vary from inexpensive box cameras to those costing as much as the teacher earns in a month. All cameras should be capable of taking time exposures as well as snapshots. In addition to these it is very desirable to have cameras of various types as part of the school equipment. Photoflood lamps and one or more tripods are quite essential. Discarded map stands or music stands form excellent standards for photoflood lamps and reflectors. An exposure meter is desirable, but less expensive guides do very well in helping students judge exposure. A window shade or two mounted on the wall will serve for backgrounds for portraits.

6. A policy with respect to financing the course should be approved by the administration and explained to the class at the outset. One workable method is to provide in the school budget for materials and supplies that will be used in getting started as well as for demonstrations, and then expect each pupil to finance his own replacement supplies. Some dealers and wholesalers furnish equipment and supplies to schools at a discount. These can be sold to the students at a price somewhat below current retail prices. To eliminate the handling of money by the teacher each student can buy a $1.00 supply card at the finance office.



On the card are printed numbers which total 100 and represent dimes, nickels, and pennies. These are punched off when supplies are purchased. It is well to tell the pupils at the beginning of the semester than they are expected to pay for their supplies and that these will cost perhaps $1.00 per month.

This whole matter of cost of supplies could easily be financed if the class were willing and able to undertake a production and sales project. Here is how the project works. The teacher or some other qualified photographer takes pictures of the athletic teams, play casts, or operetta choruses in season. Prints are made in various sizes from wallet size up to large ones for framing. Members of the groups and their friends are eager to buy, so it is no trick at all to sell them. The work comes in producing high quality prints. Pictures can also be taken for the school newspaper and yearbook at a stated fee. Such a project could be used to finance much new equipment over a period of years, but it means more work for the instructor. Two cautions are necessary here: (1) charge enough for the pictures to insure a profit and (2) collect for them before delivery.

7. An administration policy relative to who can take the course, how much credit can be earned, and how much time will be required should be clearly stated. These policies will depend largely upon local conditions. High school students of all grades can do well in photography, but juniors and seniors are preferred because of their greater maturity and more advanced preparation. In some schools one semester of photography can be substituted for a semester's work in senior science in the general curriculum. If possible a 90-minute laboratory period should be provided once or twice a week for processing. It is next to impossible to do a satisfactory job in less time.

8. One perplexing problem that the author has not solved in a satisfactory manner is that of finding a suitable textbook. The available books are too brief and incomplete or are written for college students and are too difficult for high school use. Furthermore, some of the elementary books are written by employees of a single manufacturer of photographic supplies and are definitely pointed toward the use of that manufacturer's products. One fairly satisfactory solution to this problem is to use an elementary textbook and supplement it with pamphlets and leaflets, obtained from the various manufacturers, which explain the uses of their products. This is quite satisfactory with such topics as exposure meters, enlargers filters, and special types of cameras. Magazine articles and leaflets on exposure, paper, developers, and other supplies, gadgets, and processes may be kept on file and prove very helpful to both teacher and pupil.

9. In photography as in any other laboratory science the development of a good course and a well-equipped laboratory depends very largely upon the teacher. If he feels satisfied and secure in his job and is willing to put in the time required, he can build up his equipment in a few years. The formula is to revise and improve the course each year, add as much new equipment as possible, and then take good care of it.

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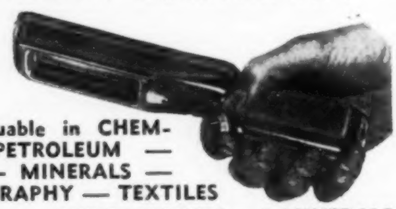

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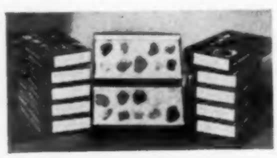

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a report from "down under"

Applied Science in the Community

By ROY W. STANHOPE
Lecturer in Science and Education
Sydney Teachers' College
Sydney, New South Wales
Australia

In January, 1951, what is thought to be the first excursion-workshop type of course for science teachers to be held in Australia was conducted during the regular post-college session of the Sydney Teachers' College. Entitled "Applied Science in the Community," the course was open to a limited number of practicing science teachers, ranging from heads of departments to assistant teachers not long out of college.

The course had two principal aims: (1) to provide participants with opportunities to acquire, through personal visitations and experiences, a better understanding of the part played by science in providing a modern city with electric power, town gas, rail and aerial transportation, and water; and (2) to provide participants with the opportunity, as a group and individually, to formulate ways and means of applying the information gained during the course to make their teaching more interesting and valuable.

The first morning of the session was devoted to registration and getting acquainted with one another. There were addresses on "The Plan and Purpose of the Course," and "Planned Developments for a Modern Sydney," followed by a discussion of the addresses.

Commencing with the first afternoon,[1] half-day conducted visits were made to the Government Railway Department's testing and research laboratories, the Kingsford-Smith International Airport and the nearby service shops of an important overseas airline company, the city's principal electric power house, the research and appliance-testing laboratories of the city's gas company, and the main gas-producing and by-products works of this latter company. At each of these public utilities, inspections were made in small groups under the guidance of members of the scientific staff. Each of the participants received, at each place visited, appropriate descriptive literature, charts, and other materials of value in teaching.

Inspection of the work in progress on the construction of a very large water-supply dam some 50 miles from the city was set down for the middle day of the course.

On the fourth day the group reassembled at the college for a very full program of last-day activities. For the first half-hour the director offered some suggestions for the utilization of community resources in science teaching, mention being made of the excellent industry-sponsored materials avail-

Roy Stanhope has been enthusiastic about NSTA for many years. Notice in his report how he speaks of "our association." He is serving as Area Director for Australia. More than 60 science teachers and university students from this land "down under" have enrolled in NSTA this year.

Mr. Stanhope gives credit to a number of science educators in this country who helped him with suggestions for his workshop course. It is our belief that this report will return the favor and plant a few ideas with us.

Well-known to a number of science education people in this country by way of spending more than a year here around 1937–38 (and taking his M.A. at Stanford), Mr. Stanhope plans to return for another visit within two or three years. Prospective visitors to Australia would do well to contact Mr. Stanhope in advance.

[1] In a workshop devoted to a comprehensive study of the public utilities of a large city an important and almost essential first trip would be to view the metropolis and its contiguous areas from the air. This was the first trip made by R. Will Burnett's "Community Workshop" group which studied the San Francisco region in the summer of 1946 (see *Education*, Vol. 68, No. 6: pp 335–340; February, 1948). However no airplane large enough to accommodate this Sydney group was available during early January when the summer vacation traffic was at its height.

able to members of our association through the Packet Service. The group then adjourned to another room where inspection was possible of all the bulletins, charts, and other materials that have been distributed to NSTA members in the 16 packets since the inception of the service.

The remaining two hours of the morning were given over to the planning by small committees, one for each industry or public utility visited, of methods of utilizing the information and experiences gained for the better organization and the greater enrichment of the teaching of science in the schools.

Presentation and discussion of the reports of the various committees occupied about two hours of the last afternoon of the course. In most cases these reports were divided into two sections: (1) the outline of a suggested content unit dealing with the particular public utility; and (2) a more or less extensive list of teaching points in which attention was directed to the application in the works or laboratories of scientific principles, processes, techniques, and facts treated in the school science courses.

Though the course was experimental in nature, since neither the director nor any of the participants had had previous experience in a course of the type offered, there was unanimity of opinion that the experiences had been most interesting and valuable from the viewpoint of the members both as citizens and as science teachers. Some of the many teachers attending other post-college courses developed an interest in the course, possibly aroused by the sight of the science group departing in a modern, comfortable bus on one of the excursions, or perhaps during lunch time conversations with some of the participants. As a result the director has been asked to organize and direct the self-same course for non-science teachers, particularly social studies teachers, during the next summer session. However, the members of this, the first course in applied science in the community, have requested that other aspects of this same general theme be treated in similar excusion-workshop fashion during each of the next two or three summers.

It should be possible in any large city to offer worth-while courses of a somewhat similar nature to that briefly described above. The following are some suggestions:

1. *Science Safeguarding Our Foods*—including visits to a bakery, a milk depot, a butter factory, a meat works, and other food processing and distributing plants.

2. *Science Safeguarding Our Lives*—including visits to public health laboratories, fire stations, blood banks, hospitals, police rescue stations, road safety organizations, water purification plants, etc.

3. *Applied Science in Modern Communications*—including visits to post office mail rooms, telephone and telegraph exchanges, cable and radio-telephone stations, radio and television studios, and newspaper offices.

In the smaller population centers, where all of these facilities are not available, combination courses could easily be devised within a suitable and comprehensive theme.

Copies of the reports prepared by members of the course are available to a limited number of interested inquirers who, however, should bear in mind that these documents are of a rather sketchy nature since the time available for their preparation was very limited. Comments on the course as it was organized and suggestions for other courses for science teachers are solicited and will be keenly appreciated.

The director wishes to acknowledge his indebtedness to many association members, including the executive secretary, for workshop materials and suggestions so readily sent him.

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Leading Science Educators To Be on Hand for NSTA Summer Meeting

Speakers for the NSTA summer meeting at Mills College, Oakland, California, June 28–30, have just been announced by the conference planning committee. They include E. Laurence Palmer, professor of nature and science education, Cornell University, Ithaca, New York, as keynote speaker; George W. Beadle, chairman, division of biology, California Institute of Technology, Pasadena; and Philip G. Johnson, specialist for science, U. S. Office of Education.

The program will get underway with an industry-science teaching conference on Thursday, June 28. Registration also will begin Thursday morning and continue through the day. (Residence halls will open Wednesday evening for early arrivals.) The first day's activities will come to a close with an evening social planned by the local committee.

Ralph W. Lefler, NSTA president, will preside at the opening general session on Friday morning, and Dr. Palmer will set the pace for the conference with his keynote address. Following this meeting the general session will break into small, informal groups built around current problems in science teaching. Leaders from many fields of science will serve as consultants and resource people for the six groups. Luncheon will be planned so that those with similar fields of interest may sit together. Discussion groups will resume their meetings from 2 to 4 o'clock in the afternoon. Speaker at the special dinner meeting will be Dr. Beadle who will consider new research in genetics.

President-elect Arthur O. Baker will preside at the third general session on Saturday morning, and Dr. Johnson will be the main speaker. Discussion groups will meet again following this session, and the conference will conclude with a special NSTA luncheon during which Robert H. Carleton, executive secretary of NSTA, will present summaries from the six groups.

Field trips to points of interest in the Oakland-San Francisco area are being planned for conference off-hours and for Sunday, July 1, just prior to the opening of the NEA Representative Assembly in San Francisco. The NSTA Board of Directors will also meet on Sunday.

Meals and dormitory accommodations on the college campus will be provided for $5 per day. Conference registration will be $1 and will include the discussion group summaries and conference report. Pre-registration forms are being sent to all NSTA members this month.

Miss Archie J. MacLean, supervisor of science education, curriculum division, Los Angeles city schools, is general chairman for the conference; Robert A. Rice, Berkeley, NSTA state director for California, is serving as chairman of local arrangements. Other chairmen include: Mabel-Ella Sweet, Los Angeles, publicity committee; Wilma M. Avery, Oakland, social committee; T. Milton Hornea, Pittsburg, registration committee; Frances Payne, Alameda, decorations committee.

Workshop for Science Teachers

Definite plans have been laid for the Workshop for Science Teachers to be held June 25–July 13 at the University of California at Berkeley. It will be presented by the School of Education and University Extension, University of California, in cooperation with the State of California, Department of Education, the U. S. Office of Education, and the National Science Teachers Association.

The three-week workshop, under the leadership of Philip G. Johnson, specialist for science, U. S. Office of Education, will include special study of such problem areas as: What should constitute proper school facilities for science instruction? What should be included in instructional guides for science teachers? How can science teachers adapt instruction to recognize individual differences?

Listed as a professional training class for teachers, this course (x 360) will carry three units of extension credit. Enrollment fee for the workshop is $27. Veterans may use the educational benefits available to them under federal and state laws to enroll in the course.

Planned as part of the workshop will be attendance at the NSTA summer conference in Oakland, June 28–30.

For further information write to the Department of Conferences and Special Activities, University Extension, University of California, Berkeley 4, California.

CLASSROOM ideas and demonstrations

Biology

He Reduces to Live

By ALBERT L. LONG, Biology Instructor, Ellenville High School, Ellenville, New York.

Would you like to maintain a living exhibit in the classroom for a school year with no more effort than the addition of distilled water to a large bottle? I had a starfish living in the biology classroom for ten months without food and regenerating four lost arms while doing it.

I found the starfish buried in rockweed at low tide on Hog Island at the Audubon Nature Study Camp of Maine. Four of its arms had been eaten off by some seashore predator. It could just be squeezed into the brown one-gallon bottle which was to be its abode for ten months. The bottle was filled with sea water to a point where the top began to narrow. A mark was placed at the level of the sea water and distilled water was added whenever evaporation was evident. No food was added for fear of contaminating the limited supply of sea water. The bottle was kept in a cool part of the room, but received no artificial aeration. The students and I were fascinated to see the animal steadily reduce in size as the lost arms began to reappear. By June the over-all size was reduced more than a half, the 100 or so tube feet were reduced to gossamer-like threads, but the four lost arms were definitely reformed.

As they peered into the brown bottle, students asked questions regarding regeneration of lost parts, dependency on constant salt-water habitat, contamination of water, and why some animals can live for months without food. This was ample reward for the little time and effort required to keep the show going.

Physics

The Screw and the Inclined Plane

By ALFRED T. COLLETTE, Dual Professor of Science and Education, Syracuse University

The simple visual aid described here will clearly illustrate that a screw is a modification of the inclined plane. The materials needed include: a three-quarters-inch wood dowel (11 inches in length or any desirable length), a piece of white oilcloth, black lantern-slide binding tape, and tacks.

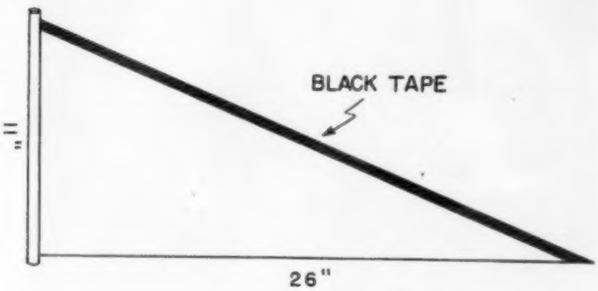
The procedure for making the device is as follows:

1. Cut the dowel about 11 inches in length.
2. Cut the oilcloth in the form of an inclined plane, 11 inches in height and 26 inches along the base.

3. Place a strip of black lantern-slide binding tape about one-eighth-inch wide along the edge of the incline (see figure below).

4. Attach the inclined plane to the three-quarters-inch dowel with tacks.

By rolling and unrolling the inclined plane around the dowel, the student can readily see the association between the screw and the inclined plane.



Chemistry

Reclaimed $KClO_3$, KCl, and MnO_2

By GEORGE F. BROWN, Laboratory Assistant, Newtown High School, Elmhurst, New York

Here is a project that will keep a number of chemistry students busy for some little while. It will prove interesting and instructive. It will provide a lesson in economy through the recovery of products which would otherwise be wasted. In our school it worked like this.

An individual laboratory experiment in the preparation of oxygen had been done by five classes. A considerable amount of $KClO_3$ and MnO_2 were used, and, as usual, only a small amount of the reagents were reacted. Two boys were set upon the task of reclaiming the remaining products.

The MnO_2 was easily recovered by heating the mixture of remaining products with one-and-one-half liters of water and filtering while hot. The residue was washed once with 500 ml. of hot water, which was added to the filtrate. It was then washed repeatedly with hot water, and the washings were thrown away. When the wash water gave practically no test for chloride, the precipitate was dried and labelled "Reclaimed MnO_2."

Since potassium chlorate is less soluble in water than the chloride, it was easy to fractionally crystallize the two salts. The chloride is nine times more soluble at 0° C. The original filtrate, therefore, was cooled out-of-doors (it being winter at the time). Any precipitate which formed was removed by decanting and filtering. The liquid decanted and the filtrate were combined and reduced to a little less than one-half by boiling. The solution was again allowed to cool out-of-doors. The resulting precipitate was combined with the first fraction and labelled "Reclaimed Potassium Chlorate, First Fraction." Two more recrystallizations were made after subsequent reductions in volume of the filtrate. They were marked "Reclaimed Potassium Chlorate, Second Fraction," and "Reclaimed Potassium Chloride, Third Fraction."

A marked difference can be noticed in the crystals that form during successive stages of the separation. The first group, which is largely the chlorate, precipitates in large flakes. The second group, which still contains a very large percentage of the chlorate, also comes down in large flakes, but there can also be seen some typical rectangular salt crystals of the chloride. The third precipitate, which is largely chloride, contains only a small amount of chlorate crystals.

The reclaimed $KClO_3$ was used again in the preparation of oxygen. Nearly all of the MnO_2 was recovered. The reclaimed products were shown to the class as an example of the catalytic participation of the manganese dioxide, and the resultant reaction product, potassium chloride.

EDITOR'S NOTE: For a "discovery-type problem" involving use of known facts and laboratory skills, evaporate some of the original filtrate to dryness so as to obtain a mixture of KCl and $KClO_3$. Let one or more students take a sample and compute the per cent of each salt in the mixture from the loss of weight (oxygen) upon heating.

Elementary Science

Toys Useful in Teaching Science

By ABRAHAM RASKIN, Assistant Professor of Biological Sciences and College Examiner, University of Chicago

Teachers on all levels now recognize the usefulness of simple toys in the teaching of science. Some of the more obvious ways in which toys can be used in science teaching are the following.

1. To emphasize the need for developing real understanding.
2. To introduce the development of a generalization or a concept.
3. To demonstrate the application of a principle.
4. In the development of a generalization or a concept.
5. As convenient motivating devices.

Most of the toys listed in the following tabulation were chosen largely for use on the elementary level. However, some may be more suitable for higher levels. All of the toys listed were purchased in the Chicago area and, no doubt, are widely available elsewhere. The classification used was for convenience. In no way does it attempt to point to an organization for a course of study or to a method of development for a teaching situation.

The writer will appreciate full data on suggestions for additions to this list of toys useful in teaching science at any level.

Light

Name of Toy	Manufactured by	Distributed by	Price
Polaroid lens	Johnson Smith and Co., Detroit, Michigan		.35 each
Tank prisms		Army surplus stores	.29 each
Flip movies	Johnson Smith and Co., Detroit, Michigan		.15
Symmetrizer (kaleidoscope)	N. J. Daniels Tool Co., Inc., Haverhill, Massachusetts	Vaughan's Seed Store, Chicago, Illinois	.50

Air

Name of Toy	Manufactured by	Distributed by	Price
Sail-me trick flying airplane	Gordon Specialties Co. c/o K F Enterprises, 35 So. Dearborn Street, Chicago 3, Illinois	Walgreen's	.25 for two
Strato-flyer jr. (helicopter)	Action Toy Co., Inc., Newark, New Jersey	5 and 10	.25
Boomerang	Johnson Smith and Co., Detroit, Michigan		.35, .69, and 1.00
Football inflater*		Walgreen's	.39
Combination sink and pump	Allied Molding Corp., Corona, New York	5 and 10	.39
Heavy rubber football (for weighing air)		5 and 10	.29

A Chicago Public School Photo
University of Illinois

It is fun to learn science by playing with toys and finding out how they work.

Sound

Name of Toy	Manufactured by	Distributed by	Price
Humming lariat	Spotswood Specialties Company, Lexington, Kentucky	5 and 10	.05
Whirling whistler	Sound Toys Company, 4802 E. 143, Cleveland 5, Ohio	Johnson Smith and Co., Detroit, Michigan	.10
String telephone	Johnson Smith and Co., Detroit, Michigan		.15
Blow-a-tune	Kenner Products Co., Cincinnati, Ohio	Marshall Field & Company	1.00
Silent dog whistle		Carson, Pirie, Scott and Co.	.50

* See Raskin, Abraham. "Services and Facilities for the Elementary School Classroom," *School Science and Mathematics,* Vol. L, No. 5: p. 371; May, 1950, for directions for converting this pump to a vacuum pump.

Water

Name of Toy	Manufactured by	Distributed by	Price
Pearl diver	Palmer Plastics, Long Island City, New York	5 and 10	.25
Magic skaters (surface tension)	Hirsch Laboratories, 226 Jackson Street, Toledo, Ohio	5 and 10	.25
Ever-drinking bird		Walgreen's	1.49
Mystery diver (Cartesian diver)	The Elklord Co., Providence 3, Rhode Island	5 and 10	.10

Magnetism and Electricity

Name of Toy	Manufactured by	Distributed by	Price
Electric motor kit	G. W. Moore, Inc., 100 Beaver Street, Waltham, Massachusetts		.20
American magnetic electric acrobat toy set		5 and 10	.10
Gremlins (statics)		Marshall Field & Company	1.00
Dot-N-Dash telegraph set	Johnson Smith and Co., Detroit, Michigan		.25
Catch-a-fish	Magnetic Toy Co., 209 S. LaSalle St., Chicago 4, Illinois	Vaughan's Seed Store, Chicago, Illinois	.50
King Tut (magnetism)	Franco-American Novelty Co., New York City	Walgreen's	.50
Mystoplane (statics)	Johnson Smith and Co., Detroit, Michigan		1.49
Radio detector	Johnson Smith and Co., Detroit, Michigan		.35
Atomic energy circus (statics)	Johnson Smith and Co., Detroit, Michigan		.35

Simple Machines

Name of Toy	Manufactured by	Distributed by	Price
Cookie and pastry tool		5 and 10	.10
Automatic window catch	Amundson Products Co., Superior, Wisconsin	5 and 10	.10
Toy egg beater		5 and 10	.10
Toy rolling pin		5 and 10	.10
Little fella scissors	The Bassonite Corp., Dayton 7, Ohio	5 and 10	.10
Nut cracker		5 and 10	.10
Furniture caster		5 and 10	.10
Double cone		Chicago Museum of Science and Industry	.90
Assorted pulleys		5 and 10	.05, .10, and .15

Energy and Forces

Name of Toy	Manufactured by	Distributed by	Price
Sundial wrist watch	Johnson Smith and Co., Detroit, Michigan		.25
Gyroscope	Monticello Mfg. Co., Elwood, Indiana	Chicago Museum of Science and Industry	.50
Jet queen boat	Tri-State Plastic Moulding Co., Henderson, Kentucky	Johnson Smith and Co., Detroit, Michigan	.59
Cum-back		5 and 10	.15
Jet auto		5 and 10	.10
Pop-pop boat	Alps (occupied Japan)	5 and 10	.29
Jitter beans	Johnson Smith and Co., Detroit, Michigan		.12
Spring top		5 and 10	.10
Magic airplane	Johnson Smith and Co., Detroit, Michigan		.15

(*Continued on next page*)

Energy and Forces (*continued*)

Name of Toy	Manufactured by	Distributed by	Price
Jet-propelled balloon	Kay Dee Plastics, Inc., New York City	5 and 10	.10
Walking penguin	Johnson Smith and Co., Detroit, Michigan		.29
Jet boat	Midland Mfg. Products	5 and 10	.10
Jet plane	Practi-Cole Products, Inc., New Haven, Connecticut	5 and 10	.10

Weather

Name of Toy	Manufactured by	Distributed by	Price
Faun forecaster (hygrometer)	Weather Barometer Co., Salem, Massachusetts	Johnson Smith and Co., Detroit, Michigan	.25
Elite weather forecaster (barometer)	Everbest Engineering Co., 41 E. 12th Street, New York City	Johnson Smith and Co., Detroit, Michigan	.49
Mystic weather forecaster (hygrometer)		Walgreen's	.49
Rain gauge		5 and 10	.29
Thermometers		5 and 10	.10 and up

Miscellaneous

Name of Toy	Manufactured by	Distributed by	Price
Things of science	Science Service, 1719 N. Street, NW, Washington 6, D. C.		4.00 yearly,
#98 Color unit #99 Magnetic unit #101 Silk unit			one "Thing" sent each month.

Miscellaneous (*continued*)

Name of Toy	Manufactured by	Distributed by	Price
#103 Stainless steel unit #104 Polyethylene plastic unit and others			
Simple microscope, magnetic compass, magnifying glass, developing kit, etc.		Various breakfast cereal companies	Varies

In General

Let the Teacher Beware

By AARON GOFF, Central High School, Newark, New Jersey

No other subject except the industrial arts is as liable to accident as the science classroom. The accidents described in this article have happened within the writer's knowledge, but fortunately not all within his classroom or laboratory. Dangers attending science experiments are not always noted in the textbook or in the manual. For instance, the mere boiling of alcohol to extract chlorophyll seems to be a simple, straightforward demonstration if one overlooks the flammability of alcohol vapor. However, if the alcohol should ignite, there is a chance of tragedy if a teacher's long hair happens to come within range of the flame. When this did happen, a fast-thinking student squirted the contents of a carbon tetrachloride extinguisher on the teacher's head and saved her from serious injury. We might add that it was great fun for the hero as well as the class.

In one case a student-made, soda-acid extinguisher exploded as soon as it was inverted in front of the class. Fortunately, damage was limited to a few drops of acid on some clothing and skin. In another instance a cloud-producing apparatus collapsed when its internal pressure was decreased. The bits of flying glass landed as far as six feet from the demonstration table. Unusual and unac-

New England Chemistry Teachers To Hold Thirteenth Summer Conference

August 20–25 have been set as the dates for the 13th summer conference of the New England Association of Chemistry Teachers, an affiliate of NSTA. This year's meeting of the association will be held at Rhode Island State College, Kingston, and once again will offer an opportunity for teachers to combine a family vacation with attendance at top-notch professional sessions.

The program will include a symposium on the teaching of chemistry with emphasis on science in general education and a workshop on pupil participation in chemical demonstrations as a classroom project. Conference attendance is open to science teachers throughout the nation.

Co-chairmen of the conference are Donald C. Gregg, University of Vermont, Burlington, and William S. Huber, Rhode Island School of Design, Providence. For further details concerning the meeting write to Rev. Leo J. Daily, St. Thomas Seminary, Bloomfield, Connecticut, director of publicity for the conference.

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countable, but true. Who knows when some flaw in a piece of apparatus will yield to a sudden force?

Once while making oxygen by the traditional chlorate and manganese dioxide method I was quite surprised to see the stopper and delivery tube fly past my nose. A little embarrassed, I smiled wanly at the class, moved the burner away, and reinserted the stopper and delivery tube. Within 30 seconds the blowout occurred again. This time I assured myself of the adequacy of the apparatus by blowing through the delivery tube and seeing black powder come out of the other end. Again I set up the apparatus and applied heat. This time it took almost a minute, but a repeat performance occurred. It was not until the period was almost over that I thought of pulling the glass tube out of the rubber stopper and examining it. Some poorly informed teacher or assistant had inserted the small jet end of a glass tube into the stopper as part of the delivery tube! The moral to this story is—inspect apparatus each time you use it, especially if it is available to others.

Once a certain type of student realizes that an explosive mixture consists of a strong oxidizing agent and a fuel, he is tempted to go into business. His "profit" is most likely to be tragedy. In the past five years our local newspapers have carried reports of at least three accidents in which fingers and hands have been mangled. The most common form of amateur bomb consists of potassium chlorate and charcoal dust packed into a pipe. The mere packing usually generates enough frictional heat to set off the mixture with terrific results. The science teacher must be on the alert at all times for any inkling of such interest or activity.

An unusual occurrence, the kind that can happen to the overconfident demonstrator, involved electrolysis of water. The teacher, during his description of the process, detached the wires from a Hoffman apparatus to explain a point. In reconnecting the wires, he inadvertently reversed the polarity. Needless to say, the ratios of the volumes were not nearly as annoying as the blast which blew the apparatus to bits when the oxygen test was applied.

Probably the most dangerous science of all to teach and supervise is chemistry. Fire, pressure, and chemical action are all possible sources of damage. The handling of corrosive chemicals is always hazardous. Skin and clothing will likely suffer from sulfuric acid, phosphorus, sodium, or alkali. Even water is a hazard around such things as sodium peroxide and potassium. Perhaps the best rule is to be almost overly cautious every time we handle a burner, a gas under pressure, or any dangerous or unknown chemical.

A little-realized hazard in the study of biology came to my attention some years ago. A certain student in completing one of my first assignments, the collection of leaves for identification purposes, contracted a severe case of poison oak. Now, when I give such an assignment, I exempt those who are allergic to poison ivy, oak, or sumach and add the precaution that there is to be no trespassing, breaking of branches, climbing of trees, or endangering of life or limb.

In General

Semi-Permanent Blackboard Diagrams

By WALTER P. LARTZ, General Science Department, U. S. Grant School, Sheboygan, Wisconsin

Here is an idea I have used frequently in my classroom which may be of help to others. It is a semi-permanent marking for blackboard diagrams or maps that will allow chalk marks to be drawn upon it for illustrating and erasure without affecting the original markings.

"Borrow" some Tempera water colors from the art department, whatever colors you desire, and paint your diagram on the blackboard with a fine paint brush obtained from the same source.

The diagram will remain for as long as you wish, even after repeated erasures of chalk marks.

To erase the painted diagram—wash off with a liberal application of warm water.

Report of an Inquiry Concerning NSTA Membership

By ROBERT H. CARLETON, Executive Secretary

WITH THE ACQUISITION of *The Science Teacher* by the association last spring, it became essential for us to obtain certain factual information about the make-up, distribution, and responsibilities for purchases of our membership in order to deal more intelligently with *TST* advertisers. Accordingly, a questionnaire was sent to all individual members of the association. All categories of paid-up membership at that time totaled 5315. Omitting libraries, elementary schools, and certain institutional memberships, there were a few under 5000 individual members. Filled-out questionnaires returned in time for tabulation totaled 2425, which, for all practical purposes, represents a 50 per cent response. Following is a summary of the main points in the inquiry.

1. *What are the principal fields of interest and the instructional levels of NSTA members?* Respondents were asked to indicate only *two* main fields of interest. Grand totals of all replies were, in rank order: physical sciences, 63.0 per cent; biological sciences, 42.0 per cent; junior high school science, 28.2 per cent; science clubs, 20.0 per cent; teacher training, 18.1 per cent; science in elementary schools, 12.0 per cent; earth science, 9.9 per cent; other 1.7 per cent.

With today's membership hovering around the 6000 figure, it appears that NSTA includes about 3600 teachers of chemistry and physics, about 2400 of biology, and about 1500 of junior high general science.

As for instructional levels of *teachers only* about five per cent reported "elementary only," 78 per cent "secondary only," and 16 per cent "college only." Of the total number of respondents, not quite five per cent reported that they were administrators or supervisors.

2. *How are NSTA members distributed according to city size?* The returns on this question are summarized in the table below.

Category of Membership	City Size						
	Over 500,000	100,000–500,000	30,000–100,000	10,000–30,000	5000–10,000	2500–5000	Under 2500 or Rural
Adm. & Supv.	26.0%	13.0%	13.0%	8.0%	4.0%	5.0%	30.0%
Ele. Tchrs.	50.0	15.0	5.0	12.0	2.0	5.0	12.0
2ndry Tchrs.	20.8	15.1	13.0	15.6	7.8	7.2	20.6
Grand Total	24.4	14.4	12.0	15.3	6.9	6.7	20.0

3. *For what annual expenditure for books, supplies, and equipment are NSTA members responsible?* Respondents to the questionnaire were asked to base their estimates of expenditures on the average of the previous two to four years. The table below shows the total expenditures of those reporting and an estimate, based on the ratio of the number reporting to the total membership of the association, of the total annual expenditures by all members. The figure in parentheses is the average expenditure of those reporting. This is based on 1893 respondents.

	Expenditures Reported	Estimated Expenditures of all NSTA Members
Textbooks, workbooks, and lab. manuals	$ 470,901 ($249)	$1,250,000
Supplementary reference books	104,673 (55)	275,000
Laboratory supplies and equipment	982,500 (519)	2,600,000
Projectors, films, and audio-visual aids	236,721 (125)	625,000
Miscellaneous items	85,067 (45)	225,000
TOTAL	$1,879,862 ($993)	$4,975,000

The size of return should constitute a reliable sample. If it does, the NSTA membership is responsible for the expenditure of about $5,000,000 annually for books, supplies, and equipment including audio-visual materials.

4. *How many science teachers not members of NSTA read members' copies of* The Science Teacher? Returns on this part of the questionnaire indicate that members' copies of the association journal are read regularly by *one or more* nonmembers in 47.2 per cent of the cases. The average number of additional readers per person reporting one or more additional readers is 2.1. The

average for all respondents, therefore, is roughly one additional reader per member.

In this question we were trying to get at an estimate of total readership of *The Science Teacher*. From the preceding figures it appears that total readership by science teachers is about double the total circulation to science teachers. This indicates 10,000 or more regular readers of the journal.

Since the total readership of *The Science Teacher* appears to be about twice the membership, and assuming that these science teachers have responsibility for expending monies for supplies and equipment that is about equal to those reporting, the indications are that the total readership of the association journal represents the responsibility for recommending purchases amounting to approximately ten million dollars annually.

From Hollywood to Science Classroom

By MAURICE BLEIFELD

Chairman, Department of Biology and General Science
Newtown High School, Elmhurst, New York

Two new classroom films, *Madame Curie* and *Yellow Jack*, will soon be available to science teachers. These new visual aids have been excerpted from the original full-length pictures that were produced in Hollywood several years ago. The work of preparing these excerpts was done by a Motion Picture Committee* of NSTA in cooperation with Teaching Film Custodians, a nonprofit affiliate of the motion picture industry.

Madame Curie has a running time of 23 minutes. The picture starts with a picturization of the discovery of uranium radioactivity by Becquerel. It then shows how radium was identified in pitchblende and how a minute amount of it was isolated after arduous labors under the most trying conditions. The film imparts an understanding of the painstaking work of scientists, an insight into their methods, and an appreciation of the human side of scientists. It is suitable for showing in general science, chemistry, and physics classes.

Yellow Jack has a projection time of 29 minutes. The film depicts the efforts to track down the *Stegomyia* mosquito as the carrier of yellow fever. It shows the experiments with human guinea pigs, in which one group was bitten by infected mosquitos, while another group was exposed to intimate contact with the soiled articles of victims of the disease. It concludes with scenes showing how the city of Havana was freed from the scourge of yellow fever. The film shows the aspects of a planned experiment, the necessary controls involved, and is a tribute to the heroism of those who risked their lives in searching for scientific truth. It is suitable for biology and general science classes.

In reducing the original films to excerpted versions, first, the original script was studied for portions that would be useful in an excerpted science film. Then the 35-mm. film footage that would serve as the excerpt workprint was purchased from the Hollywood producing company. This was put together into an excerpt that followed the selected portions of the script.

This excerpt was then viewed a number of times until the members of the committee were in a position to determine opportunities for additional editing, sound-track peculiarities due to cutting of scenes, length of projection time, fade-in and fade-out scenes, suitability of content for science classes, and need for explanatory titles. A 16-mm. print was made and examined critically a number of times until the committee felt satisfied with it.

A road-testing program of evaluation of the new film was then launched. The film was (and still is being) shown to science classes and teacher groups. Recorders were present in science classes to note student reactions, methods of teacher presentation, opportunities for integration with the syllabus, difficulties in comprehension, and grade-level suitability. From these records, and from conferences with teachers who used the film in their classes, it is expected that teachers' guides for eventual use with the films will be drawn up.

Expenses incurred in preparing these films are borne by Teaching Film Custodians. Editorial work is under the direction of John E. Braslin. The evaluation program is being conducted under the direction of Mark A. May, Reign S. Hadsell, and John Howell, of the School of Education, Yale University.

*Members of the Motion Picture Committee were: C. Michael Adragna, School of Education, New York University; Frieda Chrystall, Julia Richman High School, New York City; Patricia Mahoney, Junior High School 220, Brooklyn, New York; Jerome Shevell, Astoria Junior High School, Queens, N. Y.; Stanley Weiss, science coordinator, School Districts 12, 13, 14, New York City; Maurice Bleifeld, *chairman*, Newtown High School, Elmhurst, N. Y.

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BOOKS Review

Sourcebook on Atomic Energy. Samuel Glasstone. 546 pp. $2.90. D. Van Nostrand Company. New York. 1950.

Dr. Glasstone has gathered between the covers of one book an amazing amount of material on the nature, development, and use of atomic energy. In doing so, he traced the developments of concepts and the discovery of principles from the beginnings with the result that the *Sourcebook on Atomic Energy* provides an excellent review of the progress of physics during the first half of the 20th century.

In the chapter on "The Utilization of Nuclear Energy," Dr. Glasstone has given an excellent account of the mechanism for the sustained release of nuclear energy and has included, in addition, a great deal of the non-secret information on the construction and operation of the various types of nuclear reactors. Another chapter is devoted to the medical, biological, and industrial applications of radioactive isotopes which are now available in large amounts as by-products of nuclear reactor work.

Although the volume was prepared at the instance of the Atomic Energy Commission as a sourcebook on atomic energy for the use of textbook authors and editors, it has, as Chairman Gordon Dean of the commission has pointed out in the foreword, "far broader usefulness" and "provides a source of basic atomic energy information for everyone interested in this field."

Bernard B. Watson
U. S. Office of Education

Flowers—A Guide to Familiar American Wildflowers. Herbert S. Zim and Alexander C. Martin. 157 pp. $1. Simon and Schuster. New York. 1950.

Flowers, the second book of the *Golden Nature Guides*, is an excellent pocket-size manual for the beginner who wishes to know more concerning the wildflowers about him. Two hundred sixty flowers, grouped mainly by genera, are organized into four sections based upon color. The authors have accomplished this rather difficult feat of color arrangement by placing the plant in the color group in which it most commonly occurs. Other shades in which it is found are often shown. At the end of each color section is a list of plants with at least some species having the color mentioned, but with the description occurring elsewhere.

Among the helps given the beginning observer are aids in how to use the book, where to find wildflowers, a page on wildflower conservation, a good color plate, and a simple description of floral parts. Suggestions for amateur activities such as photography and the growing and collecting of wildflowers are given along with a short bibliography for those interested in further information.

Descriptions are brief and clearly indicate important points of distinction as well as growth habits. Range maps, family names, and flowering periods are included. Rudolph Freund is to be congratulated on his beautifully executed paintings of plants in their natural habitats which accompany each description.

Dorothy V. Phipps
Chicago Teachers College

Principles and Experiments for Courses of Integrated Physical Science. Vaden W. Miles. 430 pp. $2. 1950. (Available from Vaden W. Miles, Wayne University, Detroit, Michigan.)

This book is the report of a research study of the principles and experiments which are suitable for integrated courses of physical science. It should be very helpful to any teacher who is now teaching, or planning to teach, such a course. Dr. Miles first traces the development of physical science courses in our high schools and then takes as his particular problems for this study "(1) to determine the relative importance of the principles of physical science which are desirable for inclusion in an integrated course of physical science for senior high school; and (2) to determine the relative values of the experiments which are desirable for inclusion in such a course, and whether each of those experiments would more appropriately be done as a laboratory experiment or as a demonstration."

A jury of five experienced teachers evaluated a list of 272 principles of physics (including meteorology and astronomy), chemistry, and geology. Two hun-

dred fourteen of these principles were accepted as being desirable, were rated in descending order of desirability, and are now published in that order in this book. Hundreds of experiments were allocated to these principles and then evaluated by the jury on the basis of their effectiveness as an aid in teaching these principles. A list of several hundred experiments which did not rate so highly and an extensive bibliography are also included.

This reviewer has used the book in the following manner. Principles and their ratings were typed on index cards which were then sorted and filed under the titles of the units of the course being developed. Notations of suitable demonstrations and laboratory experiments were made on the cards. The principles and experiments for any unit were then organized into a workable outline for the unit. This system enables the instructor to develop an integrated course which is suited to the needs of his pupils, which fits his own experience, training, and interests, and which has the backing of a carefully-conducted research study of the relative importance of the principles.

The book should be influential in keeping physical science courses on a college-preparatory level comparable with physics and chemistry courses which to some extent they are replacing.

Mahlon H. Buell
Senior High School
Ann Arbor, Michigan

Methods and Materials for Teaching General and Physical Science. By John S. Richardson and G. P. Cahoon. 485 pp. $4.50. McGraw-Hill Book Co., Inc. New York. 1951.

The authors, science education specialists on the staff of the College of Education, Ohio State University, present an up-to-date volume in the true spirit of post-war teaching. "The curriculum," they write in the preface, "is evolving from an emphasis on subjects and textbooks to a concern for student experience." Distinctly formal instruction in high school science is no longer an acceptable practice; distinctly formal training of a high school teacher is likewise inadequate. Stressing this point of view, this book will help "good high school science teaching" along.

The pages that concern the different types of laboratory practices are by no means equalized in this book, but the reasons are doubtless good. The high school teacher of physics receives the largest assistance—in 154 pages. Next comes the general science teacher with 75 pages for his needs; next the chemistry teacher with 54 pages. These include demonstrations and experiments in detail.

The biology teacher is not left out, although no specific space has been assigned to his laboratory problems. He—with all other science teachers—is well advised in Part I of the book, covering a broad area as its title, "Laboratory Experiences for Science Teaching," attests. A study of Part I reveals many

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suggestions as to student projects, field trips, visual and auditory aids, the procurement and care of equipment, and similar practical matters. Many of these are obviously of value to the adaptable teacher in the grades who enriches her classes with science. And no college instructor on the freshman level could fail to gather ideas from the 183 pages of this Part I for use in his course in physical science in the spirit of general education.

There is quite properly some presentation of the philosophy and objectives of science teaching. This, however, is neither abstract, prolonged, involved, nor generally uninteresting as is typical of some "educational principles" of professional origin. As one reads Richardson's and Cahoon's ideas on the matter, he says to himself, "These fellows have actually taught in high school. They do not merely spread out theories and expect *us* to 'implement' them. We are constrained to believe that whenever a gadget is pictured or diagramed on these pages either Cahoon or Richarson has set it up."

There is no significant duplication of the standard laboratory manuals in the high school sciences, for these, of course, are available to any teacher.

The book is liberally illustrated with line drawings. There is no mathematics, and a minimum of formulas involving substitutions. These, too, are in the texts. A considerable number of references to magazine articles offers the teacher with access to a good library of bound volumes a chance to read the originals. An appendix enlarges upon these sources.

HANOR A. WEBB
George Peabody College for Teachers
Nashville, Tennessee

ATOMIC ENERGY AND THE HYDROGEN BOMB. Gerald Wendt. 192 pp. $2.75. Medill McBride Company. New York. 1950.

THIS hard-hitting, fast-moving book is directed at the alert nonscientist, and is intended to help him keep up-to-date in these days of nuclear progress. To achieve these aims, the author uses a dramatic style and takes care never to belabor a scientific point into technical tedium. Mathematics is used only where necessary, and then never beyond arithmetic, which is effectively applied to topics varying from destruction ranges to binding energies. The excellent photographs and drawings are well selected; although these illustrations are liberal in number, the average reader would probably welcome them in at least twice their present quantity.

Like many others writing in this area Dr. Wendt includes in his book the historical development of man's control of the atom, elementary nuclear physics, the effect of atomic explosions, and, of course, the prospects of the hydrogen bomb. The book devotes rather less space to basic chemistry than do most other publications in this field. Most refreshing is the inclusion of such highly interesting, but often neglected, topics as the structure and function of the Atomic Energy Commission, peacetime benefits and social implications of atomic energy, and military implications, both from the defensive and offensive viewpoint.

The bold style, the endless facts and data, and the fine illustrations combine to give this book a ring of authenticity and accuracy. In an ever-expanding array of volumes on "Atomic Energy for the Citizen," this reviewer rates *Atomic Energy and the Hydrogen Bomb* as definitely one of the best.

ROBERT STOLLBERG
San Francisco State College

BASIC SCIENCE—A TEXTBOOK IN GENERAL SCIENCE. J. Darrell Barnard and Lon Edwards. 631 pp. $3.40. The Macmillan Company. New York. 1951.

ALTHOUGH it is not stated, this book seems to be written for the ninth grade. Thirteen units and 31 chapters are used to cover the major concepts and understandings in the following areas: the earth, the universe, health, radiant energy, electricity, heat, weather, biology, work and power, transportation and communication, and conservation. The material is organized around 80 problems which carry the student through steps of the scientific method to an understanding of the environment, adjustments which the student should make to that environment, and adjustments of the environment to improve living conditions. The book uses a double column format.

Many problems of living in the environment are touched upon. The two chapters on health are concise, covering body functions, cause and control of diseases, and effects of alcohol and tobacco. The authors show an unusual honesty in the treatment of the effects of tobacco.

Many excellent three-dimensional illustrations marked by fully-explanatory captions are to be found in the book. Frequent reference to the illustrations appears, but there are still many illustrations which seem to be used as fillers, rather than related to text materials. Several colored illustrations are to be found. The one opposite page 216 is an interesting example of the progress of science.

One of the best features of the book is to be found in the summary and activities at the end of each problem and at the end of each unit. Well-organized demonstrations and experiments, tests of ability to apply knowledges gained, self-tests, suggested investigations, projects, special reports to be made by pupils, and tests of ability to interpret data presented in chart form make this book outstanding in its field. Many reading suggestions which are modern and up-to-date are very helpful in using this book.

The greatest weakness is to be found in the larger number of units and the wide field of science to be covered in one year. Few classes will be able to cover all this material; no one area can be covered thoroughly—none are. Too many extraneous topics are brought in which serve only to confuse the larger problems. As an illustration, the lead storage battery

is given three inches of text in one column. The nickel-cadmium battery gets two inches of space. How many ninth graders are likely to come in contact with a nickel-cadmium battery?

The symbolism of science—use of symbols, formulas, equations, and mathematics—seems to be entirely missing from this book. This is a serious omission since the use of these devices is becoming an ever-increasingly important aspect of our environment, and we cannot begin too soon to bring our students in contact with them.

A teacher using this book at the ninth-grade level will find it useful for the average student, a bit difficult for the slow learner, and not too helpful for the brighter students. A great deal of selection of material would have to be exercised, and supplementary materials in the form of symbols, formulas, equations, and mathematics would have to be supplied by the teacher.

KEITH C. JOHNSON
Board of Education
Washington, D. C.

READINGS FOR THE ATOMIC AGE. Edited by M. David Hoffman. 406 pp. $2.80. Globe Book Company, Inc. New York. 1950.

AMERICAN textbooks reached maturity with the publication of *Readings for the Atomic Age*. The title is misleading to this reviewer for the implications, content, and philosophy contained in this little book bring into the open the dream which educators have had in recent years, a dream which now can claim one step toward reality. A better title might well be an *Experiment in Twentieth Century Education*.

Herein lies a challenge equally as important as that described in the foreword by David E. Lilienthal—a challenge to teachers to make education meaningful and vital to the young people who are our charge.

In this collection of short essays one can't help but be sensitive to the fact that this is an approach to a synthesis of knowledge, to an understanding that is a complex of social studies, sciences, English, and other humanities that form a part in our curricula offerings. It is refreshing to find a book that is concerned with a presentation of an entire problem rather than one that is only concerned with greater specialization.

A look at the contributors bears out this very fact. An Einstein concerned with what lies "In the Hearts of Men," a Vannevar Bush intrigued with "Free Men," a Hutchins, a Cousins, and a Baruch giving evidence that atomic energy requires a thinking that is not represented by isolated cells but only by a thinking compatible with a recognition in the unity that is modern life.

In a nation that still can record but 50 per cent of its secondary schools as offering courses in physics and chemistry, this book represents an answer to the question, "How much science should be taught in the social studies?" To those that do offer these sci-

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ences the book represents a new horizon in their teaching, a mutual interest, and a point of departure for those who are attempting to build a living curriculum.

Moe Frankel
Clifford Scott High School
East Orange, New Jersey

The Indoor Bird Watcher's Manual. Helen Ferril and Anne Folsom. 64 pp. $1.00. Duell Sloane and Pearce. New York. 1950.

Any one with an interest in biology and a sense of humor or a desire to have an hour of real relaxation cannot afford to miss this delightful handbook with it's parodies on human foibles.

It offers 45 species of indoor birds commonly seen but seldom recognized for what they really are. Such ubiquitous types as the "Blue-nosed Killjoy," "Red-headed Hen-pecker," "Double breasted Seersucker," "Red-eyed Blerrio," the "Stool Pigeon," and the "Fertile Dove" provide a real chuckle.

For each bird details of habitat, distinguishing characteristics, scientific name, and call have been given.

The book is interestingly illustrated with comic line drawings.

Hubert J. Davis
Norfolk County Schools
Portsmouth, Virginia

American High School Biology. Charlotte Grant, Keith H. Cady, and Nathan A. Neal. 888 pp. $3.28. Harper Brothers. New York. 1948.

A good high school biology textbook which approaches the subject from the relation of basic principles of biology to the student's personal problems. It is organized to lead the pupil from personal things to his responsibility and opportunities to improve health facilities in the home, community, and nation.

It stresses the basic biological functions and develops fully such timely and practical topics as mental health, behavior, reproduction, heredity, and genetics. It stresses the relationship of biological principles to social and cultural problems.

Conservation of natural and human resources has been fully developed. Home life, housing, nutrition, and personal health have been fully discussed.

The illustrations are clear, appropriate, and timely. The vocabulary seems about as non-technical and simple as possible in a biology book on the high school level. Much attention has been given to audio-visual materials. Adequate pupil-teacher helps have been included. This is a most teachable high school biology textbook for general education in the field of health and biological science for the high school.

Hubert J. Davis
Norfolk County Schools
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PRECIPITATES

Announcements, News, and Views of Current Interest

Timely and helpful, "Polio Pointers for 1951" is the title of a news release from Education Service, National Foundation for Infantile Paralysis, 120 Broadway, New York City 5. Six each of important "Do's" and "Don'ts" are given in brief and simple language. Useful even with young children, the pointers could form the basis of valuable lessons in general science, biology, and with home room groups.

Latest 35-mm. filmstrip released by Visual Sciences, Box 599NST, Suffern, New York, is titled *You and the Atom Bomb.* It consists of 80 illustrations in nontechnical style on personal aspects of survival during an atomic attack. Price, $3.

Authoritative and readable is the new 20-cent pamphlet, *Your Blood Pressure and Your Arteries,* published by the Public Affairs Committee, 22 East 38th Street, New York City 16. Pointing out that "most people with high blood pressure can do more for themselves than can be accomplished by surgery or drugs," the pamphlet suggests and explains a few short rules for such persons. The American Heart Association, sponsor of the pamphlet, is seeking to stimulate public support of research in the cardiovascular field. As the pamphlet points out, "Until a few years ago the amount of money spent on research in diseases of the heart and circulatory system was hardly enough to cover the advertising budget of a five-cent candy bar."

In addition to his recent publication, *Principles and Experiments for Courses of Integrated Physical Science,* which is reviewed in this issue, Vaden W. Miles, Wayne University, Detroit 1, has prepared a separate bibliography on integrated science courses in general education. Interested teachers, supervisors, curriculum workers, and researchers may write to the author for copies.

A new 16-mm. color movie, *Journey to Banana Land,* is announced for free loan by the Institute of Visual Training, 40 East 49th Street, New York City 17. Designed for use with the social studies curriculum of grade schools, the complete visual unit, including the film, a 34-frame filmstrip, and a teachers manual, was prepared with consultation of New York University professors of education.

Pointing up the need for training engineers and others in the writing of scientific papers and reports is the new book, *Report Preparation,* published by the Iowa State College Press, Ames, Iowa. Examples of excellent business correspondence and more than 100 specimens of blueprints, graphs, and similar demonstration materials are included. Price, $6.90.

Two workshops dealing with special problems of science teaching in elementary and secondary schools will be held at the University of Florida, Gainesville, during June 18–August 18. For information write Dr. N. Eldred Bingham, director of the workshop.

At Plymouth Teachers College, Plymouth, New Hampshire, June 6–29, there will be a field workshop for elementary and secondary teachers which will focus attention on problems of community and regional life in relation to the natural environment. Hubert Evans is in charge of the workshop which is primarily for science and social studies teachers. For further information write to him at Teachers College, Columbia University, New York City 27.

Second annual Conservation Education Workshop will be held at Doane College, Crete, Nebraska, the last week in May and the first week in June. It will be conducted in conjunction with the Soil Conservation Service. For information write to William F. Rapp, Jr., director.

The United Nations Education Service has been established by the NEA Committee on International Relations. Available on a subscription basis to schools and school systems, universities, and organizations, UNES will provide three principal forms of service: (1) United Nations Information for Teachers, a bi-weekly newsletter; (2) kits, pamphlets, audio-visual materials, specially-prepared teaching units, etc.; (3) UN representation for the teaching profession. Teachers, unlike other groups working for international peace, have never maintained a representative at UN. Such representation and a clearing-house function by UNES are envisioned. Subscription ranges from $20 to $50 per year, based upon enrollment. For further information write United Nations Education Service, 1201 Sixteenth Street, N. W., Washington 6.

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THE CUTTING EDGE OF SCIENCE

Recent Developments in Research and Technology

Point IV for Panama

The University of Arkansas has entered into a contract under the Point Four Program by which it takes responsibility for giving technical assistance to Panama's agricultural school, the National Institute of Agriculture at Divisa. The purpose is to develop a strengthened center at Divisa and to establish a national extension service to advise Panama's farmers. Direct participation of state institutions in Point Four work has been endorsed by the Association of Land-Grant Colleges and Universities, and the Arkansas–Panama arrangement is regarded as typical of others that are developing.

Arsenic Saves Dollars for Power Companies

A "pinch" of arsenic—one-tenth of one per cent—added to the lead used for covering electric power cables makes them last longer and allows them to carry heavier electrical loads because higher pressure can be used for the insulating oil inside the cables. Fifteen years ago it was found that copper-lead alloy is just as satisfactory for covering cables as tin-lead alloy which costs ten per cent more. This one fact about tin-lead alloy has enabled one company to save in one year nearly all the dollars it provided for research over a 20-year span. Commonwealth Edison of Chicago, through the Utilities Research Commission, has supported such research at the University of Illinois since 1929. The whole power industry has hundreds of millions of dollars invested in electric power cables under streets and alleys of every big or medium-sized city.

City Water From Forests

Water shortages in many towns and cities in recent years emphasize the importance of forested land in safeguarding municipal water supplies. The U. S. Forest Service points out that much low-grade land now in cultivation might better be growing trees and at the same time conserving water for cities. The Cedar Creek watershed owned by Seattle is cited as an example in the current annual report of the Forest Service. The city began acquisition in 1900 and now owns more than 66,000 acres—more than 100 square miles. Sustained-logging is carried on without impairing the protective and water conservation effects of forest cover on the land.

Blight-Resistant Potato Saves Critical Copper

When research on potatoes contributes to saving copper, one of the limited-use metals, that is news—and good news indeed. The Kennebec variety of potato, released two years ago by the National Potato Breeding Program of the U. S. Department of Agriculture and state experimental stations, provides just such an example.

This potato—with such good characteristics as high yield, cooking quality, and wide geographic adaptability—has that rare factor of high resistance to late blight. Its special disease resistance makes unnecessary the heavy spraying with copper-containing chemicals, the only thing that makes it possible for some varieties to produce a crop. At present about 50 million pounds of copper sulfate are used each year in spraying potatoes against late blight. In that quantity there is approximately 20 million pounds of actual copper. A sizeable reduction in the requirements for copper sulfate for this purpose will be a big contribution of "critical" copper.

Chips From the Cutting Edge

The University of Illinois, on March 29–30, dedicated its new 3.4 million-dollar East Chemistry building devoted to chemical engineering and biochemistry. Among the dedication speakers were UI president, George D. Stoddard, and Professor Adams, chemistry department head (and sustaining member of NSTA). . . . When a farmer inoculates his legume seeds with the right bacteria, he may be said to be starting a "chain reaction," say USDA scientists. Inoculation is carried out by mixing the proper legume bacteria with a carrying agent. This is moistened and mixed with the legume seed. These bacteria produce nodules on the legume roots and live off the plant, but in turn furnish the plant with nitrogen taken from the air. . . . A grant of $18,000 has been made to the University of Illinois bacteriology department for a research study of bacterial spores. Spore-producing microorganisms are responsible for most of the spoilage in canned foods. They are very resistant to heat. To kill them, especially in food that must be stored for a long time under adverse conditions such as for army use, canners must apply high temperatures for long processing times. This may impair food value. Better knowledge about the spores may avoid this.

Jefferson's Views

ON SCIENCE AND MATHEMATICS

On the 18th of June in 1799 Thomas Jefferson wrote a letter to William Greene Munford answering an inquiry whether "a further pursuit of that branch of science (mathematics) would be useful." Before reading some excerpts from that letter, recall the social climate of the times as regards science, political and religious thought, and the difficult days ahead for the young Republic. The American and French Revolutions; Napoleon; Priestley, his discovery of oxygen and his views on religion; Lavoisier and his studies of burning—all these and other thoughts flash through the memory.

Said Jefferson to young Munford:

> There are some propositions in the latter books of Euclid, and some of Archimedes, which are useful, and I have no doubt you have been made acquainted with them. Trigonometry, so far as this, is most valuable to every man, there is scarcely a day in which he will not resort to it for some of the purposes of common life. The science of calculation also is indispensable as far as the extraction of the square root and cube roots; Algebra as far as the quadratic equation and the use of logarithms are often of value in ordinary cases: but all beyond these is but a luxury; a delicious luxury indeed; but not to be indulged in by one who is to have a profession to follow for his subsistence.

Turning more specifically to science, Jefferson wrote:

> There are often branches of science however worth the attention of every man. Astronomy, botany, chemistry, natural philosophy, natural history, anatomy. Not indeed to be a proficient in them; but to possess their general principles and outlines, so that we may be able to amuse and inform ourselves further in any of them as we proceed through life and have occasion for them.

But perhaps the most significant portions of the letter are these:

> I am among those who think well of the human character generally. I consider man as formed for society, and endowed by nature with those dispositions which fit him for society. I believe also, with Condorcet, as mentioned in your letter, that his mind is perfectible to a degree of which we cannot as yet form any conception. It is impossible for a man who takes a survey of what is already known, not to see what an immensity in every branch of science yet remains to be discovered, and that too of articles to which our faculties seem adequate.
>
> . . . and it is still more certain that in the other branches of science, great fields are yet to be explored to which our faculties are equal, and that to an extent of which we cannot fix the limits. I join you therefore in branding as cowardly the idea that the human mind is incapable of further advances. This is precisely the doctrine which the present despots of the earth are inculcating, and their friends here re-echoing, and applying especially to religion and politics: "that it is not probable that anything better will be discovered than what was known to our fathers." We are to look backwards then and not forwards for the improvement of science, and to find it amidst feudal barbarisms and the fires of Spital-fields. But thank heaven the American mind is already too much opened to listen to these impostures; and while the art of printing is left to us, science can never be retrograde; what is once acquired of real knowledge can never be lost. To preserve the freedom of the human mind then and freedom of the press, every spirit should be ready to devote itself to martyrdom; for as long as we may think as we will, and speak as we think, the condition of man will proceed in improvement. The generation which is going off the stage has deserved well of mankind for the struggles it has made, and for having arrested that course of despotism which had overwhelmed the world for thousands and thousands of years. If there seems to be danger that the ground they have gained will be lost again, that danger comes from the generation your contemporary. But that the enthu-

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Directory of Educational Periodicals

The *1950 Yearbook* of the Educational Press Association of America, listing 807 educational periodicals in 44 major classifications, is now available from Ed Press offices, 1201 Sixteenth Street, N.W., Washington 6, for $1.00. The yearbook will be useful to those desiring to write for publication in the field of education and also as a guide to news outlets for those handling programs of publicity for their associations.

Thomas Alva Edison Foundation

INSTITUTES FOR SCIENCE TEACHERS

Initiation of the Thomas Alva Edison Foundation Institutes for Science Teachers was announced on March 30 by Vice-Admiral Harold G. Bowen, USN (ret.), executive director of the Edison Foundation. The Institutes, sponsored by the Foundation with the cooperation of the U. S. Office of Education and the National Science Teachers Association of the National Education Association and the American Association for the Advancement of Science, have been enthusiastically endorsed by Commissioner of Education Earl J. McGrath, President Ralph W. Lefler (NSTA), Executive Secretary Willard E. Givens (NEA), and Administrative Secretary Howard A. Meyerhoff (AAAS).

Emphasis of the Institutes will be on bringing to light the best practices for encouraging native inquisitiveness, effective methods for developing pupils' powers of careful observation, techniques for implementing creative experimentation, and skills for bringing about fruitful reading. In announcing the Institutes, Admiral Bowen said, "With the belief that the teacher is one of the keystones in inspiring young people to help themselves and that drive and the will to work will automatically provide an individual with a solid basis for accomplishment and happiness, the Thomas Alva Edison Foundation has obtained the counsel of leaders in education and industry in initiating this series of science teacher institutes for provocative discussion of vital problems."

One national and three regional Institutes will be held during 1951. Invitations to each Institute will be extended to a group of about 25 science educators—including elementary and high school science teachers—and to a small number of individuals from universities and industry. The Institutes will provide an atmosphere for significant discussions that will be to the mutual advantage of students, teachers, universities, and industry. Based upon the conclusions reached in the Institutes channels will be developed for reaching larger numbers of individual science teachers as the program proceeds.

> siasm which characterizes youth should lift its parricide hands against freedom and science would be such a monstrous phaenomenon as I cannot place among possible things in this age and this country.

Before *rereading* the above excerpts, reflect a bit upon the social climate of today—the role of scientists in the second world war, the more recent decline in public esteem of science and scientists, the struggle between democratic and communistic ways of life, loyalty oaths and security measures, the difficult days ahead for the not-so-young-anymore Republic.

Can we not gain renewed and enriched confidence from the views of Jefferson on science? Confidence that under conditions of freedom for inquiry, thought, and expression, not only science but all other forms of human endeavor make their best progress. And renewed conviction that, as Jefferson said, "every spirit should be ready to devote itself to martyrdom," in order to win the age-old struggle against tyranny over the minds of men.

Lefler Names New Magazine Board

President Ralph W. Lefler has announced new members of the advisory board for *The Science Teacher*. Reorganization of the board was approved at the St. Louis meeting last summer and provides for six members elected for three-year overlapping terms. In this, the initial year of the new framework, two members have been chosen for one-year terms, two for two-year terms, and two for three-year terms.

Members are: Marjorie H. Campbell (1951), Washington, D. C., public schools; Charlotte L. Grant (1951), Oak Park High School, Oak Park, Illinois; Morris Meister (1953), Bronx High School of Science, New York City; Elbert C. Weaver (1952), Phillips Academy, Andover, Massachusetts; Hanor A. Webb (1953), George Peabody College for Teachers, Nashville, Tennessee; and Harold Wise (1952), University of Nebraska, Lincoln. Dr. Meister has been named chairman of the board for the year 1951.

Plan for the Bright Boys

A gigantic plan to defer college students on the basis of their ability to learn rather than on their "book learning" will be set in motion soon after the White House gives approval, according to Washington observers. In May the plan calls for sending about 800,000 college students to aptitude test centers in 1200 areas to test eligibility for deferment.

Proposed by Selective Service Director Lewis B. Hershey and supported by both military and administration officials, the plan wipes out one of the great barriers to advanced education. A first draft required that students be deferred on the basis of *both* capacity to learn *and* performance in studies. The present form bases deferment on *either* scholastic standing in class *or* a specific grade in the aptitude test. Thus deferment is opened to thousands of additional students.

As it stands, the plan satisfies small and large colleges. It assures small schools that certain percentages of their students can be deferred, even if the students are unable to pass the aptitude test. At the same time—in schools which have extremely high scholastic standards—as many students as pass the tests would be deferred without regard to how they ranked in class. The proposal would give, for the first time, hundreds of thousands of students a yardstick with which to gauge their chances of staying in school.

The test will be set up with 100 as the top score and 70 as passing. If, however, more forces are needed immediately, the passing mark may rise as high as 90; if manpower needs drop, the required score for deferment may be lowered under 70. Assuming White House approval, the first tests should be conducted in the latter part of May with two additional testing periods set for June. The exams, to be given each time in all 1200 centers, will be administered by the Education Testing Service of Princeton, New Jersey.

Here, as approved in the House Committee on Armed Services report, are the provisions for deferment: All high school graduates plus college freshmen, sophomores, and juniors are deferred for a year of studies if they score at least 70 on the aptitude test. College students who achieve a certain scholastic standing in their classes are automatically deferred without taking the test. The requirements are—college freshmen, upper half of their class; sophomores, upper two-thirds of their class; juniors, upper three-fourths of their class. All students doing "satisfactory" work in graduate schools and in schools of medicine, dentistry, veterinary medicine, osteopathy, and optometry will be deferred.

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LIVING WITH LIGHT. *Better Light Better Sight Bureau.* Folder, available without charge, describing "Living with Light," a program for instruction in light and sight in 7th, 8th, and 9th grades. Program includes 3 film strips, 6 study folders and teacher's guidebook. Presents practical information on relationship of light and sight, complexity of seeing process, and importance of comfortable seeing.

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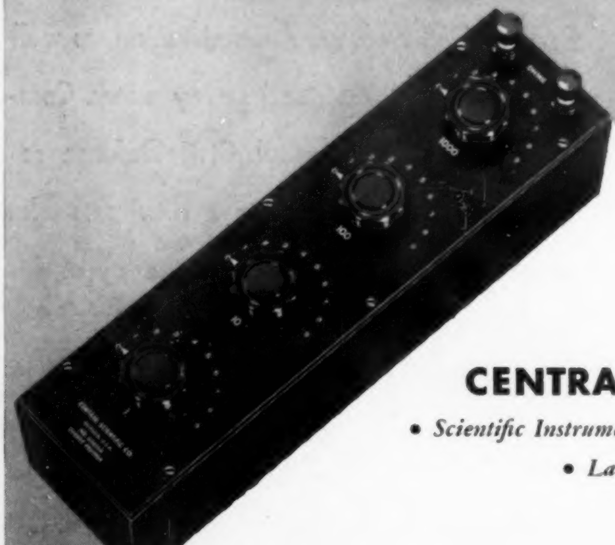

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